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Claudet. C. Cooke

D^r. Lyon Playfair, C.B., F.R.S.

D. Bogue, Fleet Street.

THE

MDCCCLIII.

THE

YEAR-BOOK OF FACTS

IN

Science and Art:

1852

EXHIBITING

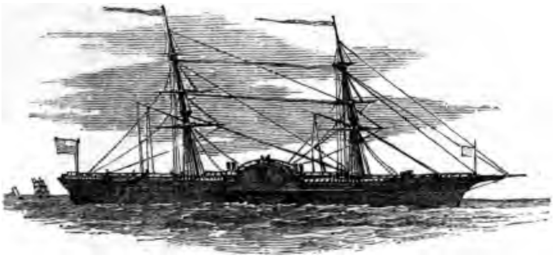
THE MOST IMPORTANT DISCOVERIES & IMPROVEMENTS OF THE PAST YEAR;

IN MECHANICS AND THE USEFUL ARTS; NATURAL PHILOSOPHY; ELECTRICITY; CHEMISTRY; ZOOLOGY AND BOTANY; GEOLOGY AND GEOGRAPHY; METEOROLOGY AND ASTRONOMY.

BY JOHN TIMBS,

EDITOR OF "THE ARCANA OF SCIENCE AND ART."

"There is no country which ought so much to glory in the progress of science as this happy island."—SIR HUMPHRY DAVY.



Ericsson's Caloric Ship.—*See page 5.*

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DAVID BOGUE, FLEET STREET.
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LONDON
SAVILL AND EDWARDS, PRINTERS, CHANDOS STREET,
COVENT GARDEN.

LYON PLAYFAIR, PH. D., C.B., F.R.S., &c.

(With a Portrait.)

THIS distinguished physicist is the second son of Dr. George Playfair, Inspector-General of Hospitals in Bengal, and was born in Bengal in the May of 1819; was sent to Scotland when about four years of age, and educated at St. Andrew's, in Fifeshire. Here he remained until fifteen, and at that very early age took especial interest in chemistry as a recreative study. From St. Andrew's, Mr. Lyon Playfair went to Glasgow in 1834, where he studied medicine, and was a pupil in chemistry of Mr. Thomas Graham, then professing at the Andersonian University; soon after, he was appointed one of Prof. Graham's assistants. His health failing, Mr. Playfair was ordered to proceed to a warm climate, and he returned to India towards the end of 1835, where he entered a large mercantile house, with the arrangement that he was to become a partner. His health being re-established, he gave up his commercial prospects, and returned to England, where he found his friend, Graham, Professor in the London University, and again became his assistant, and continued his medical studies at the University. Organic chemistry was at this time little cultivated in England, but was receiving much attention in Germany; accordingly Mr. Playfair went to Giessen in 1838, to prosecute the study of this important branch of the science, under the famous Liebig, then devoting himself specially to Agricultural Chemistry. Mr. Playfair next translated into English, Liebig's work on Agriculture, which was dedicated to the British Association; he attended the meeting of that body at Glasgow, to explain the views therein developed. Shortly afterwards he accepted the management of the large calico print-works of Messrs. Thompson, of Clithero, at a very liberal salary. Having remained in this employment for two years, he removed, in 1843, to Manchester, as Professor to the Royal Institution, and was at the same time appointed consulting chemist to the Royal Agricultural Society.

At this period, he was on the point of entering upon the Professorship of Chemistry in the University of Toronto, for which Professor Faraday had been requested to make the nomination. He had not, however, accepted the office, when he was requested to meet a party of scientific agriculturists at Drayton Manor; but, by the advice of Sir Robert Peel, Mr. Playfair declined the appointment at Toronto, and accepted a seat on the Commission then just constituted to examine into the sanitary condition of our large towns and populous districts. On this Commission, he remained two years, during which time, Mr. Playfair's Reports on the state of the large manufacturing districts were characterized by great ability. At the close of the Commission, he was appointed by Sir Robert Peel, chemist to the Museum of Practical Geology: he also served upon the Commissions to inquire into the cause of the Potato failure in Ireland; the Accidents in Coal Mines, &c.

Dr. Playfair next became associated with the Great Exhibition, at the recommendation of Sir Robert Peel, who felt the necessity of having a person acquainted with manufactures to visit the manufacturing districts, and advise the manufacturers as to the several

articles they might send with most advantage to the sugge character of the Exhibition. One of his chief duties was to ei vour, within the brief time at disposal, so to arrange with ducers, that there should be no blanks found in any cla production; but that every branch of industry should be represented, not merely individually, but in its connexion other branches. With this view, an elaborate classification o various arts and manufactures comprised in the Exhibition made by him, and adopted as the basis of the arrangement o goods in the Exhibition, and as forming the boundary-lines fo duties of the various juries.

In connexion with the Exhibition, Dr. Playfair held the app ment of Special Commissioner, in charge of the department of ju and for the great ability displayed by Dr. Playfair in this offic the close of the Exhibition, he was made a Companion of Bath, and honoured with an appointment in the establishme His Royal Highness Prince Albert, as a mark of the Royal C man's high appreciation of Dr. Playfair's scientific services. S quently Dr. Playfair delivered some valuable illustrations o benefits of the Exhibition; he was one of the Lecturers appo for that purpose in connexion with the Society of Arts; and not too much to add, that no physicist has better understood th of the Exhibition, or more efficiently laboured to carry out its g objects. His able services at the Museum of Practical Geolog also worthy of the highest commendation.

Dr. Playfair married, in 1847, Margaret, second daught James Okes, Esq., of Riddings House, near Alfreton, Derby whom he has a family.

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THE

YEAR-BOOK OF FACTS.

Mechanical and Useful Arts.

ERICSSON'S CALORIC SHIP.

(See the Vignette in title-page.)

A LARGE vessel, to be propelled by Ericsson's Caloric Engines,* has been constructed at New York, and has made experiments in the harbour, prior to her sea-trip. The latest account (to the 14th Jan.) was, that the ship went a distance of 18 miles, with and against tide, in two hours and a half, she only working at half speed. Although the leading principles involved in the construction of this vessel have already been submitted to the public, it is desirable to give a more complete description of the plan, which we condense from a recent number of the *New York Daily Times*.

The *Ericsson*, taking the name of her inventor, in appearance resembles a first-class steam-vessel. She is owned by a company of merchants in New York. The builders of her hull were Messrs. Perrine, Patterson, and Stack, of Williamsburg. Her engines are the workmanship of Messrs. Hogg and Delamater, of New York. The register of the ship is 1903 tons; her length is 250 feet, with 26 feet 6 inches depth of hold, and 40 feet breadth of beam. Her paddle-wheels, which are similar to those of the Collins steamers, differing only in being somewhat smaller, are 32 feet in diameter, with buckets of 10 feet 6 inches. The decks are abundantly provided with life-boats. The peculiar conformation of the boilers has served to produce very essential modifications in the exterior as well as the interior of the vessel. Thus, on the upper deck, in place of the ordinary smoke-funnel, as in steam-ships, the caloric-ship presents four small tubes, only 30 inches in diameter. The two corner chimneys are attached to the cylinders of the engine, and the remaining two protect the hold from the impure and heated air. No impeding machinery serves to hinder free passage of the upper deck fore and aft. The four chimneys, each resting upon a pedestal, are formed, two of sheet-iron, and two of wood. Beside each pair of these pipes is a well, extending to the bottom of the ship, through which a current of cold air is carried down to the fire-room. The mouths of these "wells" are carefully covered with tarpaulins, and the room occupied is hardly equal to a hatchway. Through the open space thus afforded, an additional advantage is given for the working of the force-pumps, the pipes of which are carried up through the entire length, pro-

* The Caloric Engine was patented by Captain Ericsson in 1833, and was described by the Editor of the present volume, in the *Arcana of Science*, 1834, p. 12. In 1834, February 14, the subject of Captain Ericsson's Caloric Engine was introduced at the Royal Institution, and described by the aid of a working model and diagrams; when Dr. Faraday, in conclusion, stated a doubt as to the working of the engine—namely, "that he could not see clearly how the difference of pressure stated by the inventor to exist, could be maintained in the different parts of the apparatus."—See *Arcana of Science and Art*, 1835, p. 36. A full description of the Caloric Engine appeared in the *Mechanics' Magazine*, vol. lv., and was republished in No. 1504 of that journal. An account of the engine also appeared in the *Mechanics' Magazine* about eighteen years since, in vol. xx. "Mr. Stirling, between thirty and forty years ago, in this country, contrived and carried into execution this principle of the expansion of heated air."—Speech of the American *Minister at Birmingham*, Jan. 21, 1853.

jecting upon the upper deck in a manner very convenient for the seamen to work them to free the ship from water. In the engine-room, the peculiarities of construction of the vessel begin to appear. The compact form of the engine leaves a free space on each side of the ship, from fore to aft, both above and below; and the shaft which turns the paddle-wheels is concealed between decks. The dining-saloons are located aft of the engine, and the state-rooms lie below; easy access to them being obtained by stairways. The appointments of the saloons, state-rooms, and other parts of the vessel intended for the accommodation of passengers are perfect and sumptuous.

The leading peculiarity of the Caloric ship, it is well known, is in the application of heated air to the propulsion of the vessel. The engine consists of two pairs of cylinders, connected in their action, but not placed side by side. Each pair is composed of two cylinders, of which the lower one is much the larger. The upper is termed "the supply cylinder;" the lower the "working cylinder." The diameter of the working, or lower cylinders, is 168 inches; of the upper, 137 inches each. The position of the cylinders is exactly in the centre of the vessel.

The operation of the engines is remarkably simple. A fire is kindled in the furnaces attached to the lower cylinders, the flames being removed to a distance of about five feet from the bottom of the cylinder. The air thus heated, seeks a vent which is readily found in a series of valves properly arranged for the purpose. The cylinders being each provided with a piston fitting closely within it, but so contrived that the pistons of both cylinders operate simultaneously, the vacuum created by the escape of the air from the working cylinder causes the descent of the lower piston; this, of necessity, draws down with it the piston of the supply cylinder, and the work of the engine is thus fairly commenced. A series of valves, each two feet in diameter, is placed in the top of each supply cylinder, and these valves instantly open at the descent of the pistons; a current of cold air rushes in, which passes down, following the piston of the upper cylinder, until it is stopped by the regenerator—the paramount contrivance, invented by Captain Ericsson. He found, by experiment, that the absorption and radiation of heat from metallic surfaces are nearly instantaneous, and that the expansive force of air when its volume is doubled by the application of heat was at least equal to the power of steam; and the application of this principle is the great feature of the Caloric ship.

The regenerator is little more than a series of fine wire nettings of iron, placed side by side, to the thickness of 12 to 20 inches. As the air passes through this mass of metallic surfaces, penetrating through the minute cells formed in the interstices of the wires, it imbibes a greater volume of caloric, which increases in temperature as the current approaches nearer to the fire beneath. The *maximum* of heat absorbed by the air in this passage through the regenerator is 450 degrees. The *minimum* necessary to be applied from below is 30 degrees, making an aggregate of 480 degrees, at which point the volume of air which has entered the engine is exactly doubled, and by the expansive force sets in motion the crank connecting the machinery, producing a revolution of the shaft, by which the paddle-wheels are revolved, and the vessel is put in motion. The manner in which these various performances transpire is remarkable. As the air passing through the regenerator has performed its work in causing the revolution of the crank, which rests upon the piston of the working cylinder—it is made to re-enter the apparatus by the upward pressure of the now ascending piston. As it passes through the regenerator, in exact reverse order, it loses the volume of heat which it had before acquired, and becomes cooler as it approaches the upper surface of the regenerator. It will thus be seen that the regenerator presents two different surfaces—one, or the upper, is the cooler, because most directly opposed to the current of cool air entering the cylinder from above; the other, warmed by the surfaces below, preserving a warm exterior; and by this contrary action the current of air, which is alternately drawn through or expelled from it, undergoes essential modifications of temperature. A very small per-centage of the volume of atmospheric air thus employed is permitted to go to waste.

The Caloric principle involves no useless expenditure of material. The supply of fuel required to continue the operation of the engine is but a few pounds of anthracite coal. There are no boilers or large furnaces, and the danger from fire *can never be so* great as to create apprehension; while, as an additional means *of security against accident,* the entire floor of the engine-room is paved with a

corrugated cast-iron pavement, the plates of which are so carefully joined together that the chance coals can neither penetrate to the woodwork, nor the water enter through the interstices left in the bed-plates, as is frequently the case in steam-ships. A number of advantages are thus combined, not only in the engine power, but in connexion with its various appurtenances.

The construction of the furnaces, and the small amount of fuel required to feed them, cause a great saving in the stowage room of the Caloric ship, by which it gains largely in accommodation for merchandise and freight. The freightage of the ship will be about 1400 tons. The freight-deck, strongly secured from accidents, is roomy and cleanly. It is perfectly clear from stem to stern, in consequence, mainly, of the small space occupied by the machinery of the ship, and affords, besides the freighting space proper, a considerable supply of store-rooms and recesses, always useful for the stowage of precious articles. The coal-hold is below the freight-deck, and is abundantly spacious to contain the entire mass of fuel required for the outward and return voyages of the ship. It is, in fact, contemplated that the vessel will be able to carry her coals for the longest trips out and back, even should the voyage be extended beyond the customary route of the American packet steamers. The advantages are secured of a saving of room, security from spontaneous combustion, and a greater degree of cleanliness, from the use of the anthracite than by the employment of bituminous coals,

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INDUSTRIAL EXHIBITIONS.

THE example of the great Exhibition of 1851 in London has been nobly followed in the two principal towns of Ireland, in New York, and in a few cities of the Continent.

Cork.—This Exhibition was opened on June 10. The structure in which the Exhibition was held was partly new—the site, the Corn Market on Albert Quay. The Corn Exchange proper formed one end or nave of the structure; the other nave, the principal show-room in the building—and called the Hall of the Fine Arts—was a half-barrel of wood, very much like the hull of a huge ship, turned upside down. Wings were added—also of a temporary character—for the more useful articles. Light was admitted by a strip of glass along the roof, as in some railway stations in England. An eye familiar with the graceful outlines and material brilliancy of the Crystal Palace in Hyde Park, wandered with some impatience about an interior so devoid of beauty and originality. The walls were covered with crimson cloth, and this in its turn was almost covered with paintings, worsted work, and engravings. Works were sedulously collected from Irish artists of eminence, whether settled in London or elsewhere. Thus, we had once more Macdowall's 'Eve and Psyche,' and Foley's two large figures—the 'Youth at a Fountain,' and the 'Wanderer'—in the hall. Maclise's 'Spirit of Justice,' a fresco of which he has executed for the House of Lords, was conspicuously placed, as it ought to be, in such a collection.

The real interest of the Exhibition centred in the industrial products. To the excellence displayed by the weaver and the lace-maker, we cannot award our praises too warmly. The poplins of Irish manufacture—the laces of Limerick and Belfast—are already famous wherever fineness of tissue and delicacy of finish are appreciated,—and their reputation must be increased by the many exquisite specimens here shown. In this direction the Irish Exhibition will probably do a great service to native industry. (*Extracted and abridged from the Athenæum.*)—The following is a more detailed description of the building:—

The principal, or fine arts court, was 177 feet long, and the dome was 53 feet span and 50 feet in height. The roof was supported by 16 semicircular laminated ribs, resting on cast-iron pillars. The end of the hall was semicircular. Six purlins ran the full length of the building. Between the main ribs, and abutting on the purlins, were intermediate smaller ribs, which carried the sheeting. An unbroken line of roof-light, 14 feet wide, glazed with 21-ounce glass, running the entire length, surmounted the whole. On either side of the hall were two galleries, each 150 feet long by 30 feet wide. It was approached from the northern hall by a vaulted arch 40 feet high and 18 feet wide, supported on ornamental pilasters, with figures on pedestals at either side. There were also two squares of sheds, each 110 feet by 85. These were for the reception of raw materials, machinery, carriages, and heavy goods. A steam-engine to keep the machinery in motion adjoined this building. The whole available space of the exhibition buildings presented a superficial area of 42,525 feet.

Dublin.—The first prize for the design of a building for this Exhibition of 1853 has been awarded to Mr. John Benson, county surveyor, of Cork; the second prize to Messrs. Deane and Woodward, of Cork; and the third prize to Mr. Turner, of Hammersmith Works, Dublin. Mr. Benson, in conjunction with Sir Thomas Deane, was the architect for the building of the Cork Exhibition. The following are particulars of Mr. Benson's adopted design. It presents a front to Merrion-square of 300 feet: the centre feature of the elevation consists of a semicircular projection, which forms the eastern termination of the central hall. This will be an apartment of 425 feet in length and 100 feet in height, covered by a semicircular roof upon trellis ribs, in one span of 100 feet. On each side of the centre hall, and running parallel to it for the same length, are two halls 50 feet wide, with vaulted roofs, similar to that which covers the main nave or hall of the building. The height from the floor to the roof of each of these halls will be 65 feet. They are approached through passages from the centre hall. In addition to these three halls are four compartments of 25 feet wide, running the whole length of the building; two are placed between the centre hall and the side halls, and two on each side of the latter; divided into sections of 25 feet square, forming convenient divisions for the purposes of classification. Over these compartments are spacious galleries, also running the length of the building, which will not only afford increased space for exhibition, but be a promenade from whence the effect of the three halls will be seen to great advantage. The ceiling of the halls being divided into panels formed by the trellis ribs, and the other constructive parts of the building, will provide opportunity for decoration. Light is admitted from the top. The construction of the building is marked on the elevation, and forms, in fact, the ornamental character of the design. There are also external galleries, which will be useful in providing access to the roof for repairs. The termination of each of the principal roofs to the east and west is *semispherical. There will* be three entrances in the front facing

Merrion-square, under a range of verandahs. The materials of the building will be iron, timber, and glass. The latter will only be used for light, as before described. The parts of the roof at each side of the lights will be timber, covered with the waterproof cloth manufactured by Messrs. Malcomson, of Portlaw, county Waterford. The trellis girders which support the galleries will be of wrought iron, supported on cast-iron pillars. The available area of ground floor will be 147,704 feet. Of wall space there will be 87,000 feet.—*From the Builder*. May 2, 1853, is the day named for the opening of this Exhibition.

New York.—The *Builder* also gives the following particulars of the edifice now in course of erection in Reservoir Square, from the plans of the successful competitors, Messrs. Carstensen and Gildemiester, of New York.—"The general idea of the edifice is a Greek cross, surmounted by a dome at the intersection. Each diameter of the cross will be 365 feet 5 inches long. There will be three similar entrances—one on the Sixth Avenue, one on the Fortieth, and one on Forty-second Street. Each entrance will be 47 feet wide, and that on the Sixth Avenue will be approached by a flight of eight steps. Each arm of the cross is on the ground-plan 149 feet broad. This is divided into a central nave and two aisles, one on each side; the nave 41 feet wide; each aisle 54 feet wide. On each front is a large semicircular fanlight, 41 feet broad and 21 feet high, answering to the arch of the nave. The central portion, or nave, is carried up to the height of 67 feet, and the semicircular arch by which it is spanned is 41 feet broad. There are thus, in effect, two arched naves, crossing each other at right angles 41 feet broad, 67 feet high to the crown of the arch, and 365 feet long; and on each side of these naves is an aisle, 54 feet broad and 45 feet high. The exterior of the ridgeway of the nave is 71 feet. The central dome is 100 feet in diameter—68 feet inside from floor to spring of arch, and 118 feet to the crown; and on the outside, with the lantern, 149 feet. The exterior angles of the building are filled up with a sort of lean-to, 24 feet high, which gives the ground-plan an octagonal shape, each side or face being 149 feet wide. At each angle is an octagonal tower, 8 feet in diameter, and 75 feet high. Each aisle is covered by a gallery of its own width, and 24 feet from the floor. The building contains on its ground floor, 111,000 square feet of space, and in its galleries, which are 54 feet wide, 62,000 square feet more, making a total area of 173,000 square feet for the purposes of exhibition. There are thus in the ground floor two acres and a half, or exactly two acres and 52·100; in the galleries, one acre and 44·100; total, within an inconsiderable fraction of four acres. There are on the ground floor 190 columns, 21 feet above the floor, 8 inches diameter, cast hollow, of different thicknesses, from half an inch to one inch thick: on the gallery floor there are 122 columns." The opening is fixed for May 2, 1853.

France.—In Paris, a building is in progress, conceded to MM. Ardoin and Co. for 35 years, the State guaranteeing a minimum interest of 4 per cent. on a capital which is not to exceed 13,000,000 francs. Before any sum is set aside for interest, the amount required

for the sinking fund is to be deducted. A sum of 50,000 francs is deposited as guarantee for the proper execution of the works:—which are to be terminated in two years. The national exhibition of the fine arts and that of manufactures are to be held in the edifice at the periods fixed by the government. At all other times the State reserves to itself, for military or other *fêtes*, the free use of the building on any two days in the week which it may select. Should the government not require the building on the two days of the week, the company may profit by that fact, on asking leave of the Minister of the Interior. During the other five days of the week, the company having the building may employ it for private *fêtes* or exhibitions. During the national exhibitions the company may demand, on the days fixed by the government, an entrance fee, which is not to exceed 3 francs, one day in the week being fixed at 50 cents. The government may at any period after the first ten years take possession of the building on condition of paying as an indemnity to the company the average of the last five years' receipts multiplied by the number of years remaining to run to the end of the concession. As the ground belongs to the City of Paris, the company is to pay to it an annual rent of 1200 francs.

Industrial Exhibitions have also been open upon various scales, in Bavaria, Berlin, Breslau, Copenhagen, Munster, Piedmont, Plymouth, Salisbury, and Sheffield.

THE NEW CRYSTAL PALACE.

THE Crystal Palace has been removed from Hyde Park, after having been purchased by a Joint Stock Company, for re-erection upon a beautiful site at Sydenham, adjacent to the London and Brighton Railway, where the first column of the New Palace was erected on August 5th. The following is the Company's plan now in progress of execution by Messrs. Fox and Henderson; the Company's advisers being Sir Joseph Paxton, Mr. Wild, Mr. Owen Jones, and Mr. Digby Wyatt. The building will scarcely present any of its original features. For the old central transept will be substituted one of greatly increased diameter and height, accompanied by two of the size of the original one, near the ends of the building; and, finally, the adoption for the whole length of the nave of a circular or wagon-headed roof of the same height as those of the two smaller transepts, into which it will merge. Thus, the wish which during the Exhibition was so often expressed, that the transept roof had been carried out throughout the whole building, will be satisfied; while over all will tower a dome of immense proportions. The wooden transept ribs will be substituted by iron ribs of increased strength and more aerial appearance: and the strength of the glass will be throughout increased by nearly one half—from 16 ounces per foot to 21. As the galleries in the existing building would seriously interfere with the growth of the plants with which so large a portion of the interior is to be filled, they will be kept back to the outside walls, except at those points (as the corners of the transepts and nave) from which the most striking views can be commanded of the *coup-d'œil*.

There will be also a narrow gallery on the third story, close under the springing of the arched roofs.

The building will form a vast conservatory, in which by simple means the most differing climates will be obtained in various parts, and the characteristic vegetation of the different quarters of the world be fully represented. Among the foliage will be interspersed casts of the most noted groups and statues of the world. There will be several quadrangles devoted to the illustration of the successive periods of architecture and ornamental art, and of national manners. Thus, the illustrations of Indian life will be collected in a representation of the court of an Indian palace, with reception-rooms, &c., and with its adjoining bazaar and shops. So also with the Chinese. The architectural series will extend from the Byzantine period to that of the Renaissance:—different courts or quadrangles being appropriated to, and filled with, specimens of the productions of the successive ages. Amongst these will be a court of the Alhambra, produced under the immediate care of Mr. Owen Jones, and a Pompeian house by Mr. Wyatt. In one of the smaller transepts will be collected exact reproductions of the most wonderful of the remains of Egyptian art, and illustrations of Egyptian manners. Among these will be conspicuous the sitting figure of an Egyptian king, from Aboo Simbel, in Nubia, more than forty-five feet high, completely coloured after the original. In the basement below the present ground-floor will be reproduced one of the large Egyptian tombs.

With the series of architectural and ornamental casts will be combined all such illustrations of extinct or dormant processes of art as may be interesting as affording either illustrations of the past or hints for the future. Thus, in connexion with decorative Italian art will be introduced specimens of fresco, tempera, mosaic, &c.,—in connexion with mediæval design, specimens of caligraphy, metal working, mural decorations, embroidery, enamel, niello, &c. Large spaces will be left for the general purposes of exhibition; in which it is intended to have geological illustrations, arranged not as mere collections, but so as to render it impossible not to comprehend the order, construction, and connexion, of the various strata and their contained fossils, the appearance of the country lying over each, &c. Also exhibitions of the great staple materials of the world, from their raw condition through all their various stages up to the most perfect manufactures,—involving the presence of machinery of the most complicated and interesting description in full work.

The grounds around the building—which are upwards of 250 acres—will be laid out as a park and pleasure-grounds, with fountains and other costly embellishments. The 2nd of May 1853, has been named for the opening of this "Palace of the People."

THE GREAT EXHIBITION BUILDING.

THE following particulars, from the accounts of Messrs. Fox and Henderson, and appended to the First Report of the Commissioners, show the expenditure for the great building, under the various heads:

Sundry Wages, &c., paid at Park	£58,238 11 11
Salaries and Expenses not included in Park Wages	950 0 0
Expended at London Works, Birmingham, principally for Cast and Wrought Iron Work	22,103 10 5
Ditto at Renfrew	990 10 5
Cast Iron	21,399 4 9
Wrought Iron	2,050 15 10
Iron and Ironmongery	1,962 12 11
Timber	31,550 13 10
Sash Bars	3,494 9 1
Doors	452 7 4
Glass	13,174 9 9
Brickwork	1,639 18 7
Masonry	156 6 4
York Curb	192 4 1
Granite	658 6 8
Paint, Oil, Brushes, Kettles, Stain, Varnish, &c.	5,049 15 10
Covering Lead-flat	866 15 8
Zinc Moulding, Lamps, &c.	309 2 6
Gas-fittings	1,323 6 9
Hire of Horses and Cartage	1,670 7 6
Saw Mills and Expenses connected therewith	673 0 8
Coals and Coke	111 19 0
Calico	1,631 2 4
Netting	247 3 2
Ladders	121 16 10
Hire of Cloths	341 19 0
Rope	399 1 3
Lime	265 18 3
Gas	48 11 9
Stationery	170 6 10
Drawings and Lithographic Plans	824 7 5
Watching	185 8 0
Miscellaneous	2,776 9 0
	£176,030 13 8

A NEW IMPLEMENT OF DESTRUCTION.

MR. JAMES NASMYTH, of the Patricroft foundry, the inventor of the all-powerful Steam-hammer that bears his name, has proposed a New Implement of Destruction which he has devised, and which he asserts is capable at one blow of destroying in an instant the largest ship of an invading enemy. The title he proposes to give to this new instrument of destruction is "James Nasmyth's Floating Mortar, or Short Range."

The chief features in this proposed destructive agent are these:—

1. A shell of great size, so constructed as to explode, *per se*, the instant it is brought in contact with the side of the enemy's ship.

2. The means by which this great shell is brought in contact with the enemy's ship consists in placing it in the chamber of a great Bray's mortar, which, as it were, forms the prow of our destructive vessel—the chamber of the mortar being six feet below water line, and the mortar being made so far part and parcel of the vessel, which would weigh about 600 tons; the entire mass of our destructive vessel comes into play as a most effective means for absorbing all the reaction consequent on the discharge of the monster touch-and-go-off shell, so that the three or four men, who would be all that are required to attend to the navigation of our floating mortar, would not experience any sensible effect from the discharge of the shell.

3. By reason of the peculiar barrel-like construction of the vessel, on the prow of which the great mortar is fixed, and the thickness of the timber on all sides, *being from nine to ten feet,* and that of poplar wood, not only would the interior, *where the steam-engine* and crew are placed, be perfectly inaccessible to the

effect of either red hot or cold shot, but by reason of the barrel-like form of the vessel it would present in most positions, no surface favourable to shot taking effect; and as the means of propulsion would consist of a suitable compact steam-engine, of the most simple construction, and a screw propeller submerged some ten or twelve feet below water, both the crew and machinery would be quite out of harm's way.

4. As respects the construction of the shell, it would be of the most simple character, being somewhat in the form of a huge thimble, or somewhat similar to the Minie rifle ball, containing a suitable charge of powder, and having a self-exploding cap at the breech end, and the shell so arranged in the chamber of the mortar as that the crushing action resulting on the protruding end of the shell being brought in contact with the hull of the enemy, the self-exploding cap is thereby forced in contact with the breech of the mortar, and the shell instantly explodes in contact with the side of the enemy, into which it tears its way, leaving a hole as wide as a church door. The result to the enemy I leave to imagination to picture.

The instant before contact it would be well to reverse the engine, so as to back off and leave the enemy to his well-merited fate.

The shell would be encased in a copper water-tight case, so that it might be placed in the chamber of the mortar, and remain there six feet under water line for years without injury of any kind, ready for action whenever it was wanted.

Were our harbours provided with two or three of these floating mortars, which could be brought into action at any time with half an hour's notice, I am confident that no invading enemy would dare to insult our shores, as any attempt on his part to take up position and proceed to discharge troops would be followed with certain destruction from the first tap of the prow of the Floating Mortar.

A very few thousand pounds would test, in the most complete and satisfactory manner, the correctness and success of this proposed simple means of defending our coast from all invading enemies, and I trust some suitable means will be afforded, by a most full and complete demonstration of the efficiency of what I have proposed, for the protection and service of my country. I am yours most respectfully,

JAMES NASMYTH.

OFFICIAL ACCOUNT OF THE FUNERAL CAR OF THE DUKE OF WELLINGTON.

THE Lord Chamberlain having requested the Superintendents of the Department of Practical Art at Marlborough House, to suggest a suitable design for the Car, for the Funeral of the Duke of Wellington, on November 18, the following are the arrangements which were approved of by her Majesty.

The leading idea adopted was to obtain soldier-like simplicity, with grandeur, solemnity, and reality. Whatever there was—coffin, bier, trophies, and metal carriage, were all real, and everything in the nature of a sham had been eschewed. The dimensions were controlled by the height and width of Temple-bar, which will not admit anything much higher than 17 feet. The design of the Car, based upon the general idea suggested by the Superintendents, was given by the Art-Superintendent, Mr. Redgrave; but its constructive and ornamental details were worked out and superintended by Professor Semper; whilst the details relating to the woven fabrics and

heraldry were designed by Mr. Octavius Hudson—both being Professors in the department.

The Car, with its various equipments, consisted of four stages or compartments. 1. The coffin was the principal object on the Car; at the summit uncovered, having simply the usual military accoutrements, cap, sword, &c., upon it. To shelter the coffin and pall from rain, a small canopy of rich tissue, formed of a pattern suggested by Indian embroidery, was supported by halberds. The tissue consisted of silver and silk, woven by Messrs. Keith, of Spitalfields; and at the corners of the halberds were hung chaplets of real laurel.

2. The bier was covered with a black velvet pall, diapered alternately with the Duke's crest and Field-Marshal's *bâtons* across, worked in silver, and having rich silver lace fringe of laurel leaves, with the legend "Blessed are the dead which die in the Lord." The frieze was embroidered under Mr. Hudson's direction, and worked partly by students of the Female School of Ornamental Art.

3. The platform of the Car is of an architectural treatment, gilt, on which are inscribed the names of the Duke's victories. The construction and modelling were executed by Mr. Jackson, of Rathbone-place. In the centre, at the four sides, were military trophies of modern arms, helmets, guns, flags, and drums, being real implements furnished by the Board of Ordnance.

The whole was placed on a carriage richly ornamented in bronze, about 20 feet long and 11 feet wide. Professor Semper directed this portion. The modelling was executed partly by Mr. Whittaker, a scholar, and Mr. Willes, a student of the department, and partly at Messrs. Jackson's establishment. The modelling of the Duke's arms was entrusted to Mr. Thomas. The castings were apportioned out as follows:—The wheels to Messrs. Tylers, of Warwick-lane; the corner figures of Fame, holding palms, to Messrs. Stuart and Smith, of Sheffield; the panels of Fame to Messrs. Hoole, of Sheffield; the lion's heads to Mr. Messenger, of Birmingham; and the spandrels, moulding, and Duke's arms to Mr. Robinson, of Pimlico.

The Carriage, built by Messrs. Barker, was drawn by twelve horses, (with embroidered velvet housings, on which were the Duke's arms,) three abreast, led by Sergeants of the Horse Artillery. The superintendence of the whole was entrusted to Messrs. Banting.

The Car will be deposited in the Arsenal at Woolwich; and the superb pall in Chelsea Hospital.

THE DEPARTMENT OF PRACTICAL ART.

MR. HENRY COLE, the general superintendent of this new department of the Board of Trade, located at Marlborough House, has opened the session with an address on the facilities afforded by the Department to all classes of the community in obtaining Education in Art. The first portion of his lecture was directed to an explanation of the position which the Department occupied with reference to the public and the Government. The confidence of the former it sought to conciliate, by laying aside everything like official reserve in its management, by the adoption, as far as possible, of the self-sup-

porting principle; and by endeavouring gradually to defray its expenses less and less from the Treasury of the country and more and more out of the pockets of the persons who came to receive instruction. Its present dependence on Government aid he defended on the plea of necessity alone, considering that the ultimate success of Art Education must depend upon its being made to pay its own expenses. Mr. Cole gave an interesting *résumé* of past experiences on this subject, laying it down as the strongest deduction therefrom that, in order to improve Manufactures, the earliest work was to elevate the Art Education of the whole people. The Government, he said, had at length broadly affirmed the principle that an elementary knowledge of form and colour should become part of the national education. The Department was therefore gradually carrying out a system by which it was hoped that all schools in the United Kingdom, even the most humble, would be enabled to acquire this elementary knowledge. He explained the steps that had already been taken by the preparation and distribution of examples and models, chiefly with eleemosynary institutions; and expressed his sanguine expectation that it would not be long before the institutions for the education of the upper and middle classes made the teaching of form and colour part of their course. From elementary instruction, as a part of general education, Mr. Cole anticipates the formation of distinct schools for carrying the practice of art still further; and these schools, thus naturally arising out of sense of their necessity and value, would, he hoped, be frequented by all classes, and gradually become connected with local museums and libraries. He then passed to the subject of advanced schools for Technical Art Education, and to the special classes of that kind established at Marlborough-house. Mr. Cole described the steps which had been taken by the Department to form a library and museum; and concluded by stating that, as far as practical on self-supporting principles, the Department would endeavour to encourage and assist, but not supersede, all local efforts to introduce education in the elements of form and colour into schools of all kinds; to promote the establishment of special schools for the practice of advanced studies; to afford instruction in the specialties of manufacture, so far as they regulated the nature of the art to be applied; and, lastly, to establish a central museum of arts and manufactures applicable to direct instruction. In all these various objects the principle would be to give assistance half-way, but no further.—*Times.*

CHEPSTOW RAILWAY BRIDGE.—RAISING THE TUBE.

THIS singular Railway Bridge (described in the *Year-book of Facts*, 1852, p. 39), was partly raised on April 12. The great tube, 309 feet in length, and 9 feet in diameter, and with the chains, weighing about 240 tons, was supported on a massive timber framework at each end resting upon iron rollers lying across a railway; and power-

ful crabs were used for drawing and pushing the tube along the stage, which projected 160 feet into the river. At the end of the stage three pontoons, braced together, were lying in the river, and these received the east end of the tube, which was made fast to it; and as the tube was projected forward the pontoons were moved across the river, and kept in their direct course by cables attached to strong moorings both up and down the river, worked by other crabs upon the pontoons.

To raise it, three sets of chain lifting tackle were employed; the lower parts of these chains being of 3-inch iron, each tested to bear a weight of 80 tons without injury. Suspension rods at these points pass through the diameter of the tube. These chains extended from a timber framing at the top of the east pier, 180 feet above the railway level, and were worked by three double crabs of great power, worked by twelve men to each.

EFFECTS OF A FLOOD AT HOLMFIRTH.

MR. PRESTWICH has described to the Geological Society, the district between Manchester and Huddersfield, and the valley of the Holme and the Digley in particular, the upper part of which latter valley had been dammed up in 1844, to form the Bilbury Dam reservoir, which burst on Feb. 4, 1852, destroying great part of the village of Holmfirth, and a great number of lives. Mr. Prestwich described the effects of the rush of water on the removal of the *débris* of the embankment and of the surface of the valley. The weight of the materials swept away from the gap were estimated at from 40,000 to 50,000 tons, which were scattered in gradually increasing quantity for a distance of half-a-mile. Near the embankment the valley is very narrow, and the action of the water on the slopes of its sides, tore up the surface to a depth of from ten to twenty feet, and carried away large masses of rock to considerable distances. The bulk of the *débris* scattered over the valley, consisted mostly of angular fragments of rock, not exceeding one or two feet in diameter; but amongst them a few large blocks occurred. Three blocks of various sizes, and weighing respectively from about five to eight tons, were transported a distance of half-a-mile; and another, 22 feet long, 6 feet broad, and 3½ feet thick, and not weighing much less than 20 tons, was carried down a third of a mile from the parent rock. After detailing many of the effects produced on buildings and trees standing in the way of the flood in different parts of the valley, the author observed that as the valley consists of open flats and narrow passes, in these latter the force of the flood was most particularly felt,—the *débris* being for the most part deposited in the more open space succeeding each pass. At the passes, the waters, being again pent up, tore up fresh materials, and transported them to the next open space. This was repeated in gradually decreasing force, nearly all the way to Huddersfield.

THE WEIGHT THAT CAN BE TRUSTED ON A PILE.

We find the following rule for calculating the Weight that can be safely trusted upon a Pile which is driven for the foundation of a heavy structure, by Major Saunders, in the *Journal of the Franklin Institute*.

A simple empirical rule, derived from an extensive series of experiments in pile driving, made in establishing the foundation for Fort Delaware, will doubtless prove acceptable to such constructors and builders as may have to resort to the use of piles, without having an opportunity of making similar researches. I believe (says Major Saunders,) that full confidence may be placed in the correctness of this rule, but I am not at present prepared to offer a statement of the facts and theory upon which it is founded.

Suppose a pile to be driven until it meets such an uniform resistance as is indicated by slight and nearly equal penetrations, for several successive blows of the ram; and that this is done with a heavy ram (its weight at least exceeding that of the pile), made to fall from such a height that theforce of its blow will not be spent in merely overcoming the inertia of the pile, but at the same time not from so great a height as to generate a force which would expend itself in crushing the fibres of the head of the pile. In such a case it will be found that the pile will safely bear, without danger of further subsidence, "as many times the weight of the ram as the distance which the pile is sunk the last blow is contained in the distance which the ram falls in making that blow, divided by eight." For example, let us take a practical case, in which the ram weighs one ton and falls 6 feet, and in which the pile is sunk half an inch by the last blow; then as half an inch is contained 144 times in 72 inches, the height the ram falls, if we divide 144 by 8, the quotient obtained, 18, gives the number of tons which may be built with perfect safety, in the form of a wall, upon such a pile.

THE DECIMAL SYSTEM INTRODUCED INTO THE WEIGHING OF BULLION.

The following notice has been issued at the Bank of England:—"On and from Monday the 1st of November inst., the present mode of Weighing in the Bullion-office of the Bank of England, by ounces, pennyweights, and grains, shall be discontinued, and the only weight in use at that office will be of the denomination of the troy ounce, and its decimal parts." This is another approximation to the decimal system of notation, the adoption of which will be the means of considerably simplifying our financial calculations, and towards which all alterations in the denominations of our coinage, and in weights and measures generally, must necessarily tend.

Professor Airy, in a letter to Mr. Alderman Humphery, thus speaks of the relative merits of the troy pound, and of the troy ounce, as the easiest of weights to be adopted in a decimal scale:

"Though I trust that this troy pound weight will be found, and will be carefully preserved, as likely to be in future a very valuable antiquarian monument, yet I hope that the use of the troy pound will not be encouraged in the offices of the City of London.

It was established on abundant evidence before the standard commissions that the troy pound was useless, the troy ounce alone being used in trade; and for this reason, with others, the new standard weight of England will be an avoirdupois pound of 7,000 grains. It appears that new weights are now required for the City. I beg leave most strongly to urge on your attention the great advantage of adopting multiples of 10 ounces, 100 ounces, and 1,000 ounces. I heard very lately (as a matter which had occurred in my absence, and which I have not yet verified) that the Bank of England have adopted this decimal scale from the ounce."

COOLING AIR BY MECHANICAL MEANS.

A PAPER has been read to the British Association entitled—"Remarks on the Mechanical Process for Cooling Air in Tropical Climates proposed by Prof. C. Piazzi Smyth," by W. J. M. Rankine. The most improved form of the apparatus proposed by Prof. Smyth consists:—1. Of a Compressing Pump, by which the air is to be forced into—2. a Refrigerator, consisting of a long tube, or a series of tubes, exposed to a stream of water, in which the air will be deprived of the heat generated by the compression, and from which it will escape into—3. an Expansion Cylinder, in which the air will at once become cooled by expansion to an extent nearly, but not quite, equal to that of the original heating by compression, and will propel a piston, to assist in working the compressing pump. The air will be delivered from this expansion cylinder into the building to be ventilated. The principal resistance to be overcome in this improved machine will be the friction. The author gives formulæ and rules for calculating the dimensions of the parts of this machine, and the power required to work it, supposing the friction to be known. It is difficult to estimate the amount of friction beforehand: but supposing it to be a little greater in proportion than that of a Cornish pumping-engine, the author calculates that about 25,000 cubic feet of air per hour may be cooled down from 90° Fahr. to 60° by an engine of 1 horse-power. Without the expansion cylinder, the amount of air so cooled would be only from 8,000 to 9,000 cubic feet per hour by the same engine; and it would not be so effectually done. This method of cooling air has lately been found to succeed very well in a mine in South Wales, even with very imperfect apparatus.

COLD BY MECHANICAL MEANS.

A PAPER has been read to the British Association "On the Production of Cold by Mechanical Means," by Mr. W. S. Ward, to effect the same purposes named in the foregoing paper proposed by a different method, and the substitution of the vapours of volatile liquids, — such as sulphuric ether in place of air. Mr. Ward believes the theoretical results will be the same, and some sources of loss diminished; but although he doubts whether either form of apparatus will be economically efficient, he feels that interesting results will follow well-conducted experiments on the subject.

WHIRLING FLUIDS.

A PAPER has been read to the British Association "On some Properties of Whirling Fluids, with their Application in improving the Action of Blowing Fans, Centrifugal Pumps, and certain kinds of Turbines," by James Thomson. He pointed out several curious and interesting properties possessed by masses of fluids revolving in the circumstances of one of the most ordinary kinds of whirlpools—that, namely, which is formed when water is supplied at the circumference of a widely-extended vessel, and is allowed to flow away by a central orifice in the bottom. He showed that a consideration of these properties led to the conclusion, that the efficiency of centrifugal pumps, of fans for causing blasts of air, and of turbines discharging the water at the circumference, may be greatly increased by the provision, outside of the wheel, of a space in which the water may continue to revolve, without any interruption, after it has left the wheel. He stated that he had reason to believe that the centrifugal pump of Mr. Appold was so constructed as to take advantage of this principle; and added that, to this, its superiority over other centrifugal pumps appeared to him to be in a great degree due. He mentioned that an apparatus involving the same principle has been applied, with good results, in turbines of great power constructed in America.

FLAME EXTINGUISHED BY STEAM.

THE power of Steam in Extinguishing Fire is well known to scientific men, though not so well known to the public as it ought to be. In a late sitting of the Academy of Sciences, at Paris, in November last, it was stated that a fire, which had broken out amongst some very inflammable materials in the spinning manufactory of M. Desurmont, at Seclire, in Belgium, and which had caught a quantity of woodwork, presenting a surface of eight yards square, was very soon extinguished, simply by turning on to it a small pipe, by which steam was escaping from a boiler.—*Literary Gazette*, No. 1870.

NEW APPLICATION OF THE LEVER PRINCIPLE.

A WORKING model of Messrs. Faulkner and Mayne's patent pumping engine, which, by the application of balancing and counterbalancing weights by leverage, is intended to supersede steam, is thus described in the *Manchester Courier*:—At one end of it, on a lever connected by a shaft with a pulley, the inventor places a 30lb. weight at a distance of six-and-a-half inches from the fulcrum. On the opposite end another lever is connected with a pulley half the diameter of the former one, and on which there is placed, at six-and-a-half inches from the fulcrum, another 30 lb. weight. When these levers are put in motion, the one counterbalances the other, and the power required to move them is very small. Supported on two pillars from the centre of the machine, there is a sway beam, about six feet long, which is connected at one end with two pulleys by a chain; and, consequently, when the levers are moved, the sway beam

is set in motion, and by the application of about 2lbs. of moving power, a weight of upwards of 100 lbs. placed at the other end of the beam is lifted up and down with ease. One man by this machine can do as much work as a three-horse engine.

ECONOMY OF RAILWAYS.

MR. BRAITHWAITE POOLE, in a paper read to the Institution of Civil Engineers, states, the Railway passenger traffic now exceeds annually four times the population of Great Britain, and is conveyed at three times the speed and one third the fares formerly charged by the old stage; or mail coaches whilst the cost of conveyance of merchandise, minerals, and agricultural produce has been reduced full 50 per cent., as compared with the rates charged on canals and turnpike roads fifteen years ago. The ordinary fares for passengers range from twopence three farthings to a halfpenny per mile; and for merchandise, from one penny to sixpence per ton per mile.

The author then proceeded to consider the economy which might be introduced into the working of railways, and divided the subject into sixteen different heads, each of which referred to some particular point, where it was thought a reduction of expenses might be made. The principal point advanced was the amalgamating, or working, of all the railways in four great divisions, and ensuring unity of management in every department; in the maintenance of the permanent way, and of the rolling stock, as well as in their manufacture, several improvements in the construction of the waggons being suggested.

ECONOMICAL INCREASE OF POWER AND SPEED.

MR. J. NYE has invented a mechanical application to hydraulic and steam engines, for the purpose of Increasing Power in Machinery without increasing the power of the prime mover. At a recent trial, Mr. Braidwood and staff, with a picked engine from the West of England Fire-office, attended to test the invention as applied to pumps, with the following results:—Twenty-five men at the West of England engine, throwing respectively $1\frac{1}{8}$ inch and $1\frac{1}{4}$ inch columns of water, are said to have been beaten by eighteen men at Nye's patent engine. The invention was also shown applied to a steam-engine of six horse power, and with a piston working a 6-inch stroke, which is stated to have produced a 15-inch throw of the crank in the same time and with less power than would be required to produce a 3-inch throw of the crank upon the old principle. The invention applied to a pile-driving engine, is said to be capable of yielding seven blows of the monkey struck with the same power and in the same time that the machines hitherto constructed perform one blow.

SELF-ACTING TIME SIGNAL.

MR. TIDMARSH has received a silver medal from the Society of Arts for his invention of a machine, consisting merely of a pole 16

feet high, upon which slides up and down a copper ball, of 18 inches in diameter. This ball is wound up to the top of the pole by clock-work directly a train has passed; and as it occupies exactly ten minutes in its descent, the driver of the following engine can discern at a glance how long a time has elapsed since the last train passed, and by which, at one view, he is made acquainted with the distance the next train before him has gone on, and instructing him, the while, to shut off his steam, or proceed at a more rapid rate. In the day-time the ball itself is sufficiently conspicuous, but in the night-time, or foggy weather, top and bottom lamps are employed, with a different colour to the one in the ball; thus making it an unmistakeable night signal. (The winding manipulation makes "self-acting" a misnomer for this invention.)

IMPROVED RAILWAY SLEEPER.

Mr. Godwin has suggested to the British Association an improvement, to consist in substituting a Cast-iron Chair and Sleeper for the permanent way of railways, in cases where, from the decay of the wood sleeper, it may be necessary to reconstruct the line. The fastening of the rail to the sleeper is the main feature in the invention, and consists in driving a cast-iron wedge between the rail and chair, forcing the rail upwards, and thus producing a simple and permanent fastening. Mr. Godwin suggested, as a further security against the wedges shaking loose, that they may be driven in with sal ammoniac, and thus ensure an immovable and permanent line of road.

A RAILROAD OVER ICE.

The railroad uniting the cities of Baltimore and Philadelphia, touches both banks of the Susquehanna river at its mouth.

The river here is about four-fifths of a mile in width, and forming a break in the railroad of that length, over deep water; the communication is usually kept up by means of a large steam ferry-boat, upon which the passengers cross from one bank to the other, independent trains, with their locomotives, being in waiting upon both banks.

The passengers themselves debark, when they reach the river, and gain the boat through covered buildings, which screen them from the weather; their baggage, with the car containing it, is run upon the upper deck, and being carried over, is replaced upon the railroad on the further bank, and coupled to the train in waiting there.

Now the river Susquehanna, leading to the north, in bleak and mountainous regions, brings down in the winter season great quantities of floating ice, which seriously impede the railroad ferry.

At the mouth of the river there is shoal water, in which the ice grounds, and in severe weather it forms a point of support for successive floating masses, until it sometimes gorges up for many miles above the ferry of the railway line.

In forming these "*gorges*" of ice, the cakes edge up, and freezing together in that position, form a mass of great solidity and strength, but very rough upon the surface.

While this gorge is forming, the railroad ferry is necessarily discontinued, and when it has formed, the question arises—how is the business of the railway to be resumed?

In a severe winter like that of 1851-2, the engineer of the railway sees his ferry line at Havre de Grace cut off, and the river filled almost to the bottom with a vast accumulation of cakes of ice, a foot thick, edged up, and frozen in that position, so as to present a mass of great strength, but most forbidding superficial aspect.

Mr. Trimble, the Engineer of the Railroad Company, determined to form over this rude glacier *a railroad* for his baggage and freight cars, and *a sledge road* alongside of it, upon which two-horse sleighs could carry his passengers, and, by means of towing lines, propel the freight cars over the river.

The first step was to *locate* the railroad; for upon this rough surface of ice, a straight line between the ferry landings would have required too much graduation,—too much excavation and embankment, so to speak, of ice and snow. The line was accordingly staked out with several curves, so as to reduce the labour required in grading the frozen surface; the projections, points, and ridges were cut away, and broken fragments of ice were used to fill up the hollows. Then upon condemned ties about four feet apart, with some new timber interspersed, a track was laid with U rails, of about 40lbs. to the yard, confined merely by hook-headed spikes, and without chairs.

The surface of the ice being some 10 or 15 feet below the permanent rails upon the two banks, was gained by temporary inclines, running off from the shores upon a rough blocking of cob-work, so arranged as to be adjustable, and taking advantage of a low pier on the left bank, to reduce the grade. These inclines, and the track across the ice, were connected with the main line on both banks, by suitable switches, and formed, in fact, a species of sideling nearly a mile long. Upon the inclines the baggage and freight cars were worked one way by *gravity*, and the other by *roping*, from the locomotive train. Forty freight cars per day, laden with valuable merchandise, were worked over this novel tract by the above means, and were propelled across the ice portion by two-horse sleighs running upon the *sledge road*, and drawing the cars by a lateral towing-line, of the size of a man's finger.—*Franklin Journal.*

LATTICE-BEAM VIADUCT.

A PAPER has been read to the Institution of Civil Engineers, describing the Lattice-beam Viaduct, to carry the Waterford and Kilkenny Railway across the River Nore, near Thomastown, County Kilkenny, by Captain W. S. Moorsom, M. Inst. C. E.

The span of the bridge was extended to 200 feet, chiefly in order to avoid the interference of the Inspecting Officers of the Board of Works (Ireland), whose proceedings had, in other cases, been so

vexatious as to cause great delay in the execution of works; and, in one instance, of a small arch of twelve feet span, crossing a stream, with a bottom of firm limestone rock, they had insisted on the excavation of this rock, to a depth of 6 feet below the bed of the stream, and caused the foundations to be brought up in masonry from that depth. The length of the girder enabled the piers to be constructed on the banks without the aid of cofferdams. The foundation was strong loam and gravel, for an average of about 10 feet, at which depth the limestone rock was reached. The river was subject to floods, which, rising rapidly, spread across the valley for a breadth of 180 yards, and to a depth of about 16 feet in mid-channel.

The progress of the structure was delayed by the financial affairs of the railway company; and on the original contractors resigning the work, it was completed by several others, among whom was Mr. R. Mallet, M. Inst. C. E., whose able assistance, in the execution of the work, was deservedly eulogized by the author.

Details were given of the limestone piers, the material for which was quarried contiguously to the bridge; as also of the lime, and the modes of working.

The timber used for the lattice beams, or girders, was Memel fir. The whole was worked to templates and gauges, and the beams were constructed with a curve, or "camber," regulated by cleats spiked to the staging, on which the beams were built. The intersections of the diagonals were all very accurately fitted, and double spiked; the waling pieces were drawn close by bolts, and the joints made water tight; the diagonal flooring was then bolted and spiked down, and on the trial of the beam, it was found that, on knocking away the cleats, the deflection was about 3 inches, which gradually increased to 3¼ inches; after passing several trains across, at speeds varying between twenty miles and thirty miles an hour, the ultimate deflection (without a load), became 5⅜ inches. The maximum load had been 65 tons. The Government Inspector however tested it by a train of loaded waggons, extending the entire length of the arch (200 feet) and weighing 146 tons. The result of this was, that the beam deflected 2½ inches under the heaviest load, and rose again 1¼ inch, thus leaving a permanent deflection, after the trials were concluded, of about 6⅝ inches. The shrinking of the timber, and the regular traffic, produced a further sinking, so that now the entire amount was 7¼ inches; but the engineer had calculated and allowed for a subsidence of 9 inches.

Details were given of the quantities of materials of all kinds used in the bridge, the entire cost of which was about 8,100*l.*:—that of the timber arch alone was about 15*l.* per foot run, and the cost of the whole mass, taken as a solid, averaged three shillings and threepence halfpenny per cubic yard.—*Proc. Inst. Civil Engineers.*

TUBULAR OR SUSPENSION BRIDGE OF PLANKS.

Mr. Animi White, of Boston, U. S., and partner, have patented a new mode of constructing Suspension and Tubular Bridges, chiefly

of seasoned planks or boards, so as to supersede all necessity for the erection of piers in crossing rivers even of 1,500 feet broad by railway. The following particulars are condensed from Messrs. White and Thayer's own description :—First, erect the towers on good firm abutments, or on a rocky bank; then extend across the stream two or more sets of stringers, according to the number of roadbeds needed. Each stringer is made by selecting a tree of proper size, which is sawed square and is tapered from the top to within about 5 feet of. the base. This serves as a starting point, on which are spliced good sound boards, 6 or 7 inches in width, on a curve of 40 feet in 500, till the required length and thickness is obtained, the whole terminating in a corresponding timber, which forms the other extremity. In securing one board upon another, care is taken to fix keys of wood or iron into mortises, made into one board and half into the other, to prevent the stringer from elongating. This suspension chain or stringer is run across the stream by means of a wire cable and pulleys, and when locked and keyed fast in the towers, with the two backstays is allowed to take a catenary curve. After a sufficient number has been extended across, the suspension rods are bolted to them and to the girders, which are made slightly arching, and to the floor-joist. The rafter is connected with the stringer and top of the suspension rod, to which is bolted the roof, constructed of double diagonal boarding. The floor, if a turnpike bridge, made of double diagonal planking, bolted together, is then laid, and, in the capacity of cross-bracing, serves to render firm the whole structure. If a railroad bridge, the cross-bracing is fitted under the floor-joist in connexion with the girders. By loading either kind of bridge with double the weight it is required to sustain, the girders will be brought down to a level, and while the weight is on, the sides are covered with a double diagonal boarding, similar to that of the roof, both of which must be firmly attached to the towers and backstays, to form a part of the strength of the bridge.

RAILWAY SUSPENSION-BRIDGE OVER THE NIAGARA.

THIS bridge will form a single span of 800 feet in length. It is to serve as a connecting line between the railways of Canada and the State of New York. It is to be hung on cables of iron wire, as "the best material for the support of loads and concussions, in virtue of its great absolute cohesion, which amounts to from 90,000 to 130,000 lbs. per square inch, according to quality." The bridge will form a straight hollow beam of 20 feet wide and 17 deep, composed of top, bottom, and sides. The upper floor, which supports the railway is 24 feet wide between the railings, and suspended to two wide cables, assisted by stays. The lower floor is 19 feet wide and 15 high in the clear, connected with the upper one by vertical trusses, forming its sides, and suspended on two other cables, which have 10 feet more deflection than the upper ones. The anchorage will be formed by sinking eight shafts into the rock 25 feet deep. The bottom

of each shaft will be enlarged for the reception of cast-iron anchor plates of 6 feet square. These chambers will have a prismatical section, and be filled with solid masonry. Saddles of cast-iron will support the cables on the top of the towers. They will consist of two parts—the lower one stationary, and the upper one moveable, resting on wrought iron rollers. The saddles will have to support a pressure of 600 tons, whenever the bridge is loaded with a train of maximum weight. The towers are to be 60 feet high, 15 feet square at base, and 8 at top. The limestone used in the masonry of the towers, it is said, will bear a pressure of 500 tons upon every foot square.

The following will be the weight of this stupendous bridge:—

Weight of timber	910,130 lbs.
Wrought iron and suspenders	113,120
Castings	44,332
Rails	66,748
Cables between towers	535,400
	1,669,722

For the cables it is estimated that 15,000 wires of No. 10 will be required. At each end of the upper floor the upper cables will be assisted by 18 wire rope stays, and their strength will be equivalent to 1,440 wires: these deducted leave the number of wires in the four superior cables, 13,560; the number of wires in one cable, 3,390; diameter of cable, 9¼ inches. The railway bridge will be elevated 18 feet on the Canadian, and 28 on the American side, above the present surface of the bank, and above the present structure.—*Builder*, No. 502.

NEW IRON TRUSS BRIDGE.

We learn by the Troy (New York) papers, that a Bridge has been erected over the creek in Second-street, that city, by the inventor, Dudley Blanchard, in company with Louis Fellows; consisting of an iron truss bridge of 73 feet span, composed of 24 separate castings, after six different patterns—four to each. It weighs about five tons, of cast iron, and has about two tons of bolting. It has been tested with 40 tons on it, and no sign of deflection exhibited. The usual plan of making truss frames, is to have all the braces equal with a top and bottom chord of uniform size throughout the whole length. This bridge is constructed with braces and chords of various proportions—each part of the truss frame being made and proportioned to the strain which it has to sustain. The inventors employ less material in making a bridge of equal strength to that of the uniformed truss bridges.

SWING BRIDGE ON SOUTH-EASTERN RAILWAY.

Mr. C. May has read to the Institution of Civil Engineers a paper on the "Swing Bridge over the River Rother, at Rye, on the line of the Ashford and Hastings Branch of the South-Eastern Railway."

This bridge was constructed by Messrs. Ransomes and May, of Ipswich, from designs by Mr. P. W. Barlow. The girders are 112 feet long, 3 feet 6 inches deep in the centre, and 2 feet 6 inches at the ends, made up in four lengths, one joint being in the centre, immediately over the support, and the others between the centre and the ends. They are secured together at their ends by cross girders; the underside planed and inclined, so as to be slightly lifted, when swung home to their places, on girders secured to the land piers. Provision is made on the underside of the main girders, at three places on each side of the centre of the bridge, for receiving the tie-bars, which all tend to one point over the middle. Each tie-bar is 4 inches by 1 inch in section, and adjustable for tension by a right and left-handed screw, the nut of one end in the tie-bar, and the other between two plates of wrought-iron resting on the side standards, or A frames, which are connected together by a wrought-iron arch. The turning of the bridge is effected by spur gearing, worked from a platform, projecting from the face of each girder. Two men, it was added, can with ease open the bridge in two minutes. The total weight of metal in the moving part, exclusive of the roadway, is said to be about 130 tons.

WILLSON'S PATENT COMPOUND RAILS.

THE object aimed at by this Improvement is, to produce a Rail which shall approximate, as nearly as possible, to a continuous Bar from one end of the road to the other. This result is attained by making the Rails in two vertical and longitudinal sections, with projections on one section, and corresponding depressions or grooves on the other.

These half Rails are laid either on longitudinal wooden sleepers, or cross ties, so as to break joints, and the parts are then firmly riveted together, as shewn in the Drawings. No chairs, clumps, or plates, or any other of the numerous contrivances devised for securing the ends of the rails are required, except where the principle is applied to the double-headed rail. The rails are kept in their places by a simple hook-headed spike.

The experiments made with the *Improved Compound Rail* in the United States, have established its utility in the most satisfactory manner. It has been in use, for from one to two years, on portions of the following Railways, viz.; New York and Erie, Utica and Schenectady, Philadelphia and Reading, Syracuse and Utica, Hudson River and Central Michigan, and the engineers and superintendents of these several lines have certified that they consider it the best rail in use.

NEW EXPRESS ENGINES ON THE LONDON AND NORTH-WESTERN RAILWAY.

THE magnificent new Engines now worked on the London and North-Western Railway for the express trains are of the largest class of passenger engines yet introduced upon the narrow gauge. They

combine several important improvements, which have been patented by Mr. M'Connell, the locomotive engineer of the Company.

From the admirable proportions of all the parts, both of engines and tenders, they retain a beautiful and symmetrical appearance, notwithstanding the great power and strength of the working portion. The cylinders, which are compactly arranged inside the framing, are 18 inches in diameter, with a 24-inch stroke. The pistons, which are of wrought iron, forged solid with the rod, are, with increased strength, at least one-third lighter than when constructed on the ordinary principle; while the very rapid reciprocating motion of this part of the machine makes any reduction of weight a matter of importance. This will be better understood when it is known that it makes a difference in this instance of not less than 40 tons per minute on each piston when travelling at the rate of 60 miles per hour. The driving-wheels are 7 feet 6 inches in diameter, and the axles are hollow—a mode of construction which ensures greater soundness in the manufacture, with the advantage of increased strength, and a reduction of fully one-third of the weight. The bearing-springs and buffers are of india-rubber, prepared by an improved process, rendering its elasticity uniform, and remaining unaffected by any changes of temperature.

The more peculiar improvement introduced into the construction of these engines, however, consists in the arrangement of the boiler and tubes; thus, a portion of the fire-box is continued, or rather projected, into the barrel or circular part of the boiler, and forms a recess or chamber for the more perfect combustion of the gases evolved from the fuel in the fire-box, into which a further supply of air is admitted through hollow stays employed for the support of the combustion chamber, and communicating with the external atmosphere. Owing to this projection, the tubes traversing the boiler are much shorter than usual; but although the gases pass off at a higher temperature, a more intense heat is generated by the same quantity of fuel; thus effecting great economy in the use of coke. Experiments have been made with anthracite coal, which has been found to answer perfectly, making this improvement of great importance where coke cannot be procured, unless at an extravagant price. The application of a surcharging vessel, which has been introduced into the smoke-box for the purpose of heating and drying the steam, adds a vast amount of force to its action, and greatly reduces the consumption of fuel; not less than 50 per cent. of elastic force being obtained by this application. Small steam pumping-engines are fixed upon the foot-plates to keep up the supply of water in the boilers at all times. By this means the necessity of running out on the line, for the supplying water in the boiler, is obviated. Bourdon's pressure guage is an appendage of great convenience to the driver, by its indicating the actual pressure of steam in the boilers.—*Illustrated London News, No.* 510.

RAILWAY ACCIDENTS.

A PAPER has been read to the Institution of Civil Engineers, on "Railway Accidents; their Cause and Means of Prevention; detailing particularly the various Contrivances which are in use, and have been proposed; with the Regulations of some of the principal Lines," by Capt. M. Huish. The author first considered those points connected with the road, and the machinery employed upon it, from which loss of life and injury to person and property most generally arose. With regard to the road, or permanent way, from which fewer accidents occurred than from any other cause, its complete effectiveness was the basis of all safety in railway travelling; and for keeping it up constant vigilance was necessary, especially when any great and sudden change of weather took place, as then the weak points were sure to show themselves. It was a very rare occurrence for trains to run off the line; and when they did so, it was more generally due to obstructions designedly placed on the line than to any neglect of the superintendents or the platelayers. Owing to the rapid development of the traffic, and particularly of the heavy goods traffic, on the main arterial lines of the country, increased sidling accommodation had become necessary; in the case of the London and North-Western Railway alone, upwards of fifty-three miles had been laid down within the last few years, although, by multiplying points and crossings, this had, *pro tanto*, increased the liability of accident; for it might be received as an axiom, that anything which broke the continuity of a rail tended to develope danger. As, however, there were no means of avoiding these frequent "turns out," judicious regulations combined with effective signals must be relied on, and now that facing points were reduced in number, the liability to danger had been diminished. The use of self-acting switches was attended with evils of no trifling magnitude, and many accidents had occurred from reliance on them; indeed, as a general rule, machinery to supersede personal inspection and manipulation was fraught with danger.

With respect to the rolling stock, it appeared from a return of one thousand cases of engine failures and defects, within two years, on the London and North-Western Railway, that burst and leaky tubes nearly doubled any other class of failure, and that these, with broken springs and broken valves, amounted to one-third of the whole number; and though they caused no direct danger to the public, yet as producing a temporary, or permanent inability of the engine to carry on its train, they might be the remote cause of collision. The passenger carriage, from its perfect manufacture, presented almost complete immunity from accident, for during the last four years, out of the large stock of the London and North-Western Railway only six wheels had failed, and though at first some annoyance and alarm had been experienced from heated axles, yet by the recent introduction of the patent axle-box, it had been much reduced. The same praise could not be bestowed on the merchandise waggon, as in no portion of the system had so little improvement been made; the fracture

of axles was frequent, the mode of coupling very defective, and the want of spring buffers, or even of buffers of the same height and width, rendered the destruction of property enormous. No loss of life from fire, either from heated coke, or spontaneous combustion, had occurred to a passenger train, but there had been some narrow escapes. These and other circumstances had led many persons to suggest various contrivances for communicating between the passengers, the guard, and the engine-driver, almost all of which were identical in principle, consisting of a connecting wire, or rope. This plan had been tried and failed. A more feasible and favourite one was that recommended by the Railway Commissioners, which was to continue the foot-boards, so as to form a narrow platform, from end to end of the train, but a committee of railway officials had subsequently expressed their unanimous condemnation of the measure. The plan now adopted on the London and North-Western Railway, was for the guard's van at the end of the train, to project about a foot beyond the other carriages, so that the guard looking through a window in this projection, might notice the waving of a hand, or a handkerchief; this was, of course, useless at night.

All these causes, however, did not produce a tithe of the accidents which resulted from a want of attention to signals, and a neglect of regulations, which of all sources of danger were the most prolific. Railway stationary signals had been greatly improved of late years, and the introduction of the lofty semaphores and the auxiliary signals really left little to be desired. Besides these there were the hand signals to be used by the guards, in case of stoppages between stations, and the detonating signals to prevent collisions during a fog, which latter supplied a deficiency that had been experienced, and they were found to answer exceedingly well. The Electric Telegraph had greatly facilitated working under variable circumstances, and so beneficial had its effects been, that, during the year 1851, out of 7,900,000 passengers, or nearly one-third of the population of England, who had travelled over the London and North-Western Railway, only *one* individual had met with his death, (from which casualty the author also suffered,) and this was the effect of the gravest disobedience of orders. In the six months during which the Exhibition was open, 775,000 persons were conveyed by excursion trains alone, in 24,000 extra carriages, all centering in a single focus, arriving at irregular hours and in almost unlimited numbers, from more than thirty railways, without the most trifling casualty, or even interruption to the ordinary extensive business of that line.

The author thought undue importance had been attached to the question of irregularity in the times of the trains, as an essential element of safety, for with perfect signals and a well disciplined staff no amount of irregularity should lead to danger; but, on the contrary, it should, to a certain extent, by its very uncertainty, induce increased vigilance, and therefore greater safety. Accidents very rarely happened from foreseen circumstances, but generally from a simultaneous conjunction of several causes, and each of these was

provided for as it arose. The statistics of railways, and the periodical publication of the Government returns, drew public attention very pointedly to the aggregate of accidents; but it was believed that if due regard was had to comparative results, if the accidents to steamers, or in mines, to omnibus passengers, or even to pedestrians, were as carefully recorded, that then, whether as regarded the ease and celerity of transit, or the facility of conveying numbers, the railway system, even in its present state, would be found to be incomparably safer than any other system in the previous or present history of locomotion.

DIAPHRAGM STEAM GENERATOR.

A DESCRIPTION of this Steam Generator has been communicated to the Institution of Civil Engineers. It is based upon the principle that "bodies evaporate only from their surfaces." This being received as an axiom, it must necessarily follow that in the construction of steam-boilers, either the evaporating surface of metal should be extended to its utmost limit, or the water should be so divided, and its evaporating surfaces be so multiplied, as to arrive at the same end, of obtaining the greatest amount of steam by the expenditure of the least amount of fuel. The steam generator was described to consist of a vertical cylinder of wrought iron, 25 inches high by 12⅝ inches diameter; the base terminating in a hemispherical end, and the upper part closed by a curved lid, upon which was attached the usual steam and safety valves, feed steam, and other pipes, &c. The interior contained a series of diaphragms of wrought iron, pierced with a number of fine holes, and having alternately convex and concave surfaces. They were suspended by three iron rods, at given distances apart, in such a manner as not to be in contact with the heated exterior, or shell of the boiler. When any water was admitted through the feed pipe it fell upon the upper (convex) disc, which had a tendency to spread it to the periphery, the largest quantity falling through the perforations in the shape of globules; the second diaphragm being concave, tended to direct the fluid from the circumference to the centre, and so on, until if any fluid reached the bottom of the cylinder, it mingled with a thin film of water in a high state of ebullition, that being the hottest part of the boiler. It appeared, however, that in its transit through these diaphragms, the water was so divided, that exposing a very large surface to the caloric, it was transformed into steam with great rapidity, and with great economy of fuel. The boiler described had been worked for a long time at Paris with great success, giving motion to a steam-engine of two horses' power. The consumption of coal was stated to be very small, 789 lbs. of water having been converted into steam by 182 lbs. of coal in nine hours, under a pressure of ten atmospheres. The chemical part of the question was carefully examined, and it was shown, that at that temperature the iron was exactly in the best condition to bear strain.

MARINE BOILERS.

A PAPER has been read to the Institution of Civil Engineers,—"On certain points in the construction of Marine Boilers," by Mr. J. Scott Russell. The author having arrived at certain practical results relative to the construction of marine boilers, put them into practice about ten years back, in designing the boilers for the Royal Mail Steam Packets *Clyde, Tay, Tweed,* and *Teviot;* and as they had been in constant work ever since, running from 42,000 miles to 48,000 miles per annum, without material repairs, he believed their durability, combined with effective combustion and economy of fuel, had been fully established. The principles on which these boilers were constructed differed from those generally recognised. In the first place, it was considered that a judicious distribution of the most intensely heated surfaces would be conducive to durability; and for this purpose, instead of returning the flues over the furnaces, the top of the furnaces and the hottest flues were brought to the surface of the water, and the cooler, or return flues, were taken to the bottom of the water. The water was admitted at the bottom and was gradually warmed as it rose, the greatest heat being imparted at the last moment, by which means the bubbles of steam were prevented from accumulating in contact with intensely heated metal. In the next place the capacity of the furnaces, or fire boxes, was unusually large, and their height above the incandescent fuel much greater than usual. The evaporating surface in these boilers was also much more than customary, there being no less than three feet of evaporating surface for every foot of furnace bars. The process of blowing off was provided for by arranging under the flues and furnaces large water spaces, as reservoirs for the collection and blowing off brine and other deposit.

TUBULAR BOILERS.

A PAPER has been communicated to the Institution of Civil Engineers,—"On the Results of the use of Tubular Boilers, or of Flue Boilers of Inadequate Surface, or Imperfect Absorption of Heat," by Admiral Earl Dundonald. This communication advocated the general Introduction of what were termed "economical heat trap boilers," or boilers having vertical water tubes, instead of oblique fire tubes, contained within a chamber, into the upper of which the hot products of combustion were introduced, and allowed to circulate until, by the abstraction of heat, they descended to the bottom, and passed into the chimney at a temperature little exceeding that of boiling water. From some trials which had been made at Woolwich and Chatham in 1844, as well as from the experience which had been gained by their actual application to some of the North American Transatlantic steam packets, and some in the service of the Emperor of Russia, it was contended that these boilers possessed greater evaporative powers, and were more economical than those ordinarily in use: and, moreover, that their safety was much greater, owing to the products of combustion passing into the chimney at a very low

temperature, instead of the usual high temperature, from which it was apprehended much danger had been, and might still be, incurred.

Another new boiler, the invention of Mr. Fairbairn, and described by him to the British Association, consists of two furnaces the same as the double-flue boiler, but with this difference, that the cylindrical flues which contain the grate bars are united at a distance of eight feet from the front of the boiler into a circular flue which forms the mixing chamber, and which terminates in a disc plate, which contains a series of three-inch tubes, eight feet long, and similar to the locomotive boiler. These tubes in a boiler seven feet diameter are 104 to 110 in number, and from the thinness of the metal become the absorbents of the surplus heat escaping from the mixing chamber and the furnace. On this principle of rapid conduction, the whole of the heat, excepting only what is necessary to maintain the draught, is transmitted into the boiler, and hence follows the economy of entirely dispensing with brick-work and flues,—an important desideratum in those constructions.

AMERICAN VIEW OF THE STEAM POWER OF ENGLAND.

THERE is a most lamentable general ignorance of the Steam Power of England, both among the people there and in the United States. This we judge from the statistical facts respecting her steam navy and mercantile steam marine. Her steam navy is really terrific—being no less than 147 vessels, besides three new eighty gun propellers. One half of these only are in commission; but then she has 75 steam vessels ready for war at any moment, the average tonnage of which is 800 tons each: some of them are very small and some very large, but the smallest is fit to cross the Atlantic. The commercial steam marine of Britain numbers 1,184 steam ships and steam-boats. The city of London alone has 333 steam vessels, with a tonnage of 102,000 tons. The city of Glasgow has 88 steam ships, all fitted for sea, with a tonnage of 34,000 tons. In Liverpool there are 99 steam vessels, with an average tonnage of 21,059 tons. Thus, in three ports, there is a tonnage of steam vessels amounting to 157,059 tons. If we allow an average tonnage of 200 tons to all the mercantile marine there, it will amount to 236,400 tons.

One single Glasgow Company (the Cunard), has seven Atlantic steamships with a tonnage of 13,100 tons, and this force is to be increased about 6,000 tons. There are at least 100 steamships of 1,000 tons burden, each of which, upon an exigency, could be drafted into the British navy, and, in a few days, armed and equipped, not for defence but offensive operations.—*Scientific American.*

HYATT'S ROTARY STEAM ENGINE.

IN No. 1525 of the *Mechanics' Magazine* is described the con struction of this Engine as detailed in the specification; explaining that it consists chiefly of an elliptical cylinder of small eccentricity, having an axis passing through it a little below the lower focus of its transverse diameter, which is vertical. A piston, with a straight slot in

the middle, slides freely upon the driving-shaft, which is cut square to receive motion from it; and the longitudinal ends of the piston are furnished with knuckle-joints, to make a steam-tight contact with the cylinder in every part of the revolution. The steam is admitted into one side of the cylinders, and drives the piston round with a force due to the excess of pressure on the longer arm of the piston.

The efficiency of the principle of this engine seems to be completely demonstrated by its working. Though the cylinder is only 2 feet long, and the diameters of its elliptical section $20\frac{1}{8}$ and $18\frac{5}{8}$, it ordinarily gives 30 horse power, and working with a pressure of 32 lbs. on the inch, Rennie's dynanometer has indicated a power of 50 horse.

NEW PROPELLER.

PROFESSOR A. Crestadoro has patented a new law for Propelling Wheels with plain circumference and without paddles or blades, the use of which he regards as quite as much a mistake as the original idea of toothed wheels on locomotives. The adhesion of the water and the wheel or drum he considers sufficient for propulsion, and he proposes to immerse the drums or cylinders entirely beneath the surface of the water, protecting or covering their upper circumference (and the posterior portion of the lower?) with a semi-cylindrical case. The total cessation of the vibration produced by blades is thus anticipated. It is to be hoped that it is not the mere analogy of the iron bite of the rail, but practical experiment which has called forth a patent like this.

THE AUSTRALIAN BOOMERANG PROPELLER.*

THE steamer *Keera* has been fitted with this Propeller, the invention of Sir Thomas Mitchell; and, in the report of a trial trip in the *Sydney Morning Herald*, the vessel is stated to have gradually acquired speed, obeying her rudder from the first, so as to describe a fine curve on the water from her position off the patent slip into her direct course. The speed of the *Keera* then surpassed any hitherto attained upon the coast, traversing a distance of 2,099 yards.

On the *Keera's* trial trip on the 10th of February, she performed this distance in 8 min. 20 sec. Her strokes of the piston then were 42 per minute; in the second trip, between these points, they were 55. Greater speed, however, was soon afterwards attained. About this time, the strokes of the piston were 62 per minute; and we must particularly direct attention to the fact that, with the English screw in, the engines of the *Keera* have very seldom indeed been got to work up to 50. This serves to prove the freedom of the Boomerang

* The singular properties of that strange and mystic parabolical instrument of offence in the hands of savages, the Boomerang, have led to its adoption for the shape of screw propellers. It is known that the peculiar form of the boomerang enables it to present the least possible resistance to rapid and eccentric movement through the air, but whether such a property enables it to act to advantage in the ocean as a propeller remains to be seen.—*Ed. Builder*.

propeller from lateral resistance; while the greatest speed attained with a surface some 76 inches less than the English one, proves beyond doubt the efficiency of the Boomerang form, as an instrument of propulsion. The pressure on the boiler never exceeded 10 lbs. to the inch. Sir Thomas Mitchell's propeller combines the parabolic and cycloidal curves; equilibrium, gravitation: the laws of hydrostatics relating to the pressure on oblique surfaces under water; and more particularly, that particular law by which the area must be governed, and which the result of the above trial fully establishes, namely, "that the area of working surface should never exceed the supplement of the spiral surface over the section taken at right angles to the shaft." Every inch more than this only retards the vessel, and prevents her from attaining gradually-increasing speed.

THE CHATTERTON PADDLE-WHEEL.

THIS Paddle-wheel of a new construction has been invented by Mr. Richard Chatterton, of Cobourg, in Upper Canada.

The distinction between this and the ordinary wheels is, that the floats of the former paddles enter and leave the water horizontally, and at intervals, with violent successive concussion, and consequent disadvantage of downward pressure, attended with a great deal of unpleasant vibration and back lift, while in the latter they pass into and emerge from the sphere of resistance quietly and continuously, much after the manner of a screw, without disturbing in front or lifting the water behind, being at the same time perfectly balanced at all points, half of each float being precisely opposite a corresponding half on the other side, and each pair acting, as it were, like a wedge in passing through the water. The pressure on the shaft is thus quite as square as in the common wheel, while the displacement being the same, with a larger surface of friction exposed to the surrounding water, the propelling effect below is proportionately increased, on the well-known principle that a body wedge-shaped offers greater resistance in its transit through water with the point of the wedge foremost, than it would do if reversed, because it is more easily drawn from, than driven against, the friction on its sides. Again, the water thrown abaft the wheel, as it emerges, falls under the run of the vessel, helping to fill up the vacuum and urge her forward. The propeller has also, obviously, the further advantage of working much easier for the engine in a heavy sea, particularly a following sea, than the long square float; while in tideways, or in ascending rapid currents, the continuity of its action must prove equally beneficial.

In a trial trip on the Thames, between the *Bridegroom*, fitted with the Chatterton wheel, and the *Twilight*, with Stevens's paddle-wheel with zig-zag floats, it was proved that Mr. Stevens's wheel has an advantage over the common wheel, inasmuch as it obviates vibration, without any loss of propelling power; but that Mr. Chatterton's wheel possessed the same advantage, with a most decided gain in speed; that is to say, his wheels have made the *Bridegroom* as

fast a boat as the *Twilight,* which was previously upwards of a mile an hour faster.

The Chatterton paddle-wheel is illustrated and described in the *Mechanics' Magazine,* No. 1485.

WAVE-LINE SHIPS AND YACHTS.

MR. SCOTT RUSSELL has read to the Royal Institution the following paper on this subject, suggested by the assertion which within a year or two has been so often repeated—that our Transatlantic brethren are building better ships than ourselves.

"Two questions of a practical nature arise out of this alarming assertion:—1st, Whether the Americans are really in any respect superior to the English in nautical matters?—2nd, Whether in order to equal them we are to be condemned to descend into mere imitators, or whether we have independent ground from which we can start with certainty and originality on a new career of improvement in naval architecture? In the outset I beg permission to say, that I am not one of those who shut their ears to the praises of our young and enterprising brethren over the water, or view their rapid advancement with jealousy. I beg to express my perfect belief in the accounts we have heard of their wonderful achievements in rapid river steam navigation. I am satisfied, as a matter of fact, that twenty-one, twenty-two, and twenty-three miles an hour have been performed, not once, but *often*, by their river steam boats. To that we cannot in this country offer any parallel. The next point in which they had beaten us was, in the construction of the beautiful packet-ships which carried on the passenger trade between Liverpool and America before the era of ocean steamers. These were the finest ships in the world, and they were mainly owned and sailed by Americans. The next point at which we have come into competition with the Americans has been lately in ocean steam navigation. Three years ago they began. They were immeasurably behind us at starting,—they are already nearly equal to us. Their Transatlantic steam-packets equal ours in size, power, and speed; in regularity they are still inferior. If they continue to advance at their present rate of improvement, they will very soon outstrip us. Next I come to the trade which has long been peculiarly our own—the China trade. The clipper ships which they have recently sent home to this country have astonished the fine ships of our own Smiths and Greens. Our best shipowners are now trembling for their trade and reputation. Finally, it is true that the Americans have sent over to England a yacht, called the America, which has found on this side of the Atlantic no match; and we only escaped the disgrace of her having returned to America without any of us having had the courage to accept her defiance through the chivalry of one gentleman, who accepted the challenge with a yacht of half the size, on this principle, so worthy of John Bull, "that the Yankee, although he might say that he had beaten us, should not be able to say that we had all run away." Such, then, at present is our actual position in the matter of ships, yachts, and steam navigation:—a position highly creditable to the Americans, and which deserves our own very serious consideration. I propose to examine a little into the physical causes of the naval success of the Americans; but before doing so, permit me to point out a moral one, which later in the evening you will also find to lie at the bottom of the physical causes. It is this:—John Bull has a prejudice against novelty,—Brother Jonathan has a prejudice equally strong in favour of it. We adhere to tradition in trade, manners, customs, professions, humours,—Jonathan despises it. I don't say he is right and we are wrong; but this difference becomes very important when a race of competition is to be run.

"These preliminary remarks find immediate application in the causes which have led to our loss of character on the sea. The Americans, constantly on the alert, have carried out and applied every new discovery to the advancement of navigation; while with the English, naval construction and seamanship is exactly that branch of practice in which science has not only been disregarded, but is altogether despised and set aside. The American ships show what can be

done by modern science unflinchingly put in practice; the English show what can be done in spite of science and in defiance of its principles. The immediate cause of the defects of English ships, and the most glaring instance of the outrage of all true principle in the practice of navigation, was to be found for many years in the English tonnage law. It was simply an act of parliament for the effectual and compulsory construction of bad ships. Under that law, the present fleet of merchant ships and race of ship-builders have chiefly grown up; and though at length and only recently abrogated, its influence is still left behind and is widely prevalent. This act of parliament compelled the construction of bad ships under heavy penalties. The old tonnage law, according to which ships were built and registered and taxed and bought and sold, virtually said to the builder and owner,—'Thou shalt not build a ship of the necessary beam to carry sail; thou shalt not give her the depth and height necessary to security and sea-worthiness; thou shalt not build her of any suitable shape for speed, under penalty of 20, 30, and 40 per cent. of fine for every ton of freight so carried in such ship.' In short, the law offered a premium on a ship the amount of which was in the proportion of her being wall-sided, top-heavy, crank, unweatherly, and slow; while it inflicted a penalty in the shape of port charges and pilot, harbour dues, lights, &c. in proportion to her fitness and reputation as a sea-worthy, fast, and wholesome ship. To cheat the law—that is, to build a tolerable ship in spite of it—was the highest achievement left to an English builder, and formed his continual occupation. The manner in which the English system was opposed to the good qualities of a ship, especially speed, is only to be understood by an analysis of these qualities.

"The two examples selected for illustration of the qualities of sailing vessels were, the yacht America, built without restriction of any kind, and the yacht Titania, built under the restrictions of the law of measurement of tonnage, which is still retained in all its deformity by the English yacht squadron. It was shown how the element of 'stand-up-ativeness' is dependent on the beam of the vessel at the water-line; how the power of carrying sail depends on this element; and how this element is prohibited to the utmost by the Yacht Club's law of tonnage. Another element of the vessel, the area of her vertical longitudinal section immersed in the water, is by another portion of the law compelled to be reduced in an injurious degree. It was next shown that in the other elements of the form of the two vessels they were nearly identical; and that they were *both* under water constructed on the *wave principle* in its most perfect form. But for the existence, therefore, of these antiquated laws, our yacht-builders and our ship-builders would have had nothing to fear from competition. Happily, the mercantile tonnage law had been altered, and the new law was all that could be desired; and in consequence a new race of fast ships was rapidly springing up. The old yacht law unhappily remained. It appeared, from the comparison which was instituted between the construction of American and English vessels, that the American ship-builders have gained over the English chiefly by the ready abandonment of old systems of routine and the adoption of the true principles of science and the most modern discoveries. They have changed their fashions of steamers and ships to meet new circumstances as they arose. For river steamers they at once abandoned all the known sea-going forms, and created an absolutely new form and general arrangement both of ship and machinery. We, on the other hand, subject to the prejudices of a class, invariably attempted to make a river steamer as nearly as possible to resemble a sea-going ship propelled by sails. We were even for a long time so much ashamed of our paddle-wheels, that we adopted all sorts of inconvenient forms and inapt artifices to conceal them, as if it were a high achievement to make a steam-vessel be mistaken for a sailing vessel. The fine sharp bows which the wave principle has brought to our knowledge have been adopted in this country with the greatest reluctance; and those who adopt them are often unwilling to allow that they are wave-bows, and would fain assert that 'they always built them so' were it not that ships' lines are able to speak for themselves. The Americans, however, adopted the wave-bow without reluctance, and avowed it with pleasure the moment they found it give them economy and speed. In like manner, the Americans having found the wave-bow or hollow bow good for steamers, were quite ready to believe that it might be equally good for sailing vessels. We, on the other hand, have kept on asserting that though we could not deny its efficacy

for steamers, it would never do for vessels that were meant to carry sail. The Americans, on the contrary, immediately tried it on their pilot-boats, and finding it succeed there, avowed at once, in their latest treatise on naval architecture, the complete success of the principle; not even disclaiming its British origin. To prove to ourselves our insensibility to its advantages—they built the America, carried out the wave principle to the utmost, and, despising the prejudices and antiquated regulations of our clubs, came over and beat us. The diagrams and models which were exhibited showed the water-lines of the America to coincide precisely with the theoretical wave line. In one other point the Americans had shown their implicit faith in science and their disregard of prejudice. Theory says, and has always said, 'Sails should sit flat as boards.' We have said, 'They should be cut so as to hang in graceful waves. It has always been so; we have always done it.' The Americans believed in principle, and with flat sails went one point nearer to the wind, leaving prejudice and picturesque sails far to leeward. In other points the Americans beat us by the use of science. They use all the refinements of science in their rigging and tackle; they, it is true, have to employ better educated and more intelligent men—they *do so;* and by employing a smaller number of hands, beat us in efficiency as well as in economy.

SHIPS' BOATS.

Mr. William Stirling Lacon, of Great Yarmouth, Norfolk, has patented certain improvements in means of Suspending Ships' Boats, and of lowering the same into the water.

The object of this invention is so to suspend ships' boats at the sides or the stern of a vessel, that in the case of any sudden emergency, as the conflagration or the foundering of a vessel, her boats may be readily lowered and put to sea, without the risk of the tackles, or other contrivances which connect the boats to the ship, retarding the operations of lowering and floating them clear of the ship.

The manner in which the patentee overcomes the difficulties hitherto attendant on the lowering of ships' boats during tempests, on dark nights, and at periods of excitement and danger, is by suspending the boats from chains or ropes, which pass over the davits of the ship, and thence down to winch or windlass, round which they are wound, but are attached thereto, in such a manner that when the winch is free to revolve, the ropes or chains will unship or disengage themselves from their attachment by their own weight. By this means, he prevents the possibility of the ship, in its onward progress through a rough sea, dragging forward a lowered boat, and capsizing or swamping it; the weight of the chains or ropes, to say nothing of the resistance of the boat, being sufficient to disconnect them from the winch, and thereby render the boat free of the ship.

Mr. Lacon has described and illustrated his patent in an ably-written pamphlet.

LIFE-BOATS.

Captain Washington, R.N., has communicated to the Society of Arts a paper "On Shipping in General, especially Life-boats," (the eleventh lecture of the course on the results of the Great Exhibition). The first part of the lecture consisted of a progressive review of the art of ship-building in England from historical sources, and as illustrated

by the models and representations in the Exhibition, from *The Great Harry* in 1514 to *The Queen* (120) now afloat. A point of great general interest was touched upon in the pernicious influence of the old mischievous tonnage laws, which, in the language of the lecturer, "operated as an effectual bar to all improvement in the forms of our shipping, amounting to an act of Parliament for the compulsory construction of bad ships," and are the immediate cause of the fact that our navy is the most unsafe that belongs to any civilised country; and although these laws have been rescinded, it will be long before our shipping recovers from their baneful influence, while the statutes which have replaced them are far from being as perfect as they ought to be.

The second part was devoted to Life-boats and to the calamities which render them necessary. Captain Washington was one of the officers selected to adjudge the premium offered by his Grace the Duke of Northumberland for the best life-boat, and in his hands the conduct of the experiments was placed. It appeared from a chart of the United Kingdom, prepared under Captain Washington's care, showing the number of wrecks that had taken place in 1850 off each of the chief ports, that no less than 681 had occurred in that year, in which no fewer than 780 lives were lost. Against this statement was quoted in striking relief the statistics of the life-boats in use on the coast, which showed that Scotland, with a seaboard of 1,500 miles, had but eight life-boats; England, with her 2,000 miles, but 75, and for the whole of Ireland but 8, and those in a most inefficient state. From Falmouth, round the Land's End, for a distance of 150 miles, there is not one efficient boat.

It may be interesting to the public to know what were the qualities deemed indispensable for an efficient life-boat, and included in the Duke of Northumberland's stipulations.

1. Power of *self-righting* in the event of being upset.
2. Lightness for easy launching or transport along the coast.
3. Power of freeing itself from water shipped.
4. Smallness of cost.

These qualities were found combined only in the boat constructed by Messrs. Beeching, of Great Yarmouth, to which the prize was adjudged, and on which experiments, thoroughly testing its powers, have been made during the gales of the past winter, by Captain Washington, with the most satisfactory results. Not satisfied with having elicited a perfect life-boat, the Duke has undertaken to place one at each of the eight most exposed points of the coast of his county, and Manby's rockets and mortars at the intermediate stations.

Captain Washington went fully into the History of the Life-Boat, as well as into detailed criticism, on the more worthy of the 280 sent in, in competition for the prize: these our space will not admit of our reporting. A curious instance of the RE-INVENTION which is of such frequent occurrence, and of which several instances have been brought to light in the course of this series of lectures, is, that the

power of self-righting, the demand for which was received with ridicule by the boat-builders of 1850, was actually possessed by a life-boat, for which their silver medal and twenty guineas were given by the Society of Arts, in 1809, to the Rev. James Bremner, of Orkney, who had then for many years had his boat in use and under severe trial on the Scotch coast. The Society gave a gold medal and fifty guineas, in 1802, to Mr. Greathead, of South Shields, who designed and built for the then Duke of Northumberland a life-boat which has hardly been since surpassed.—*Literary Gazette*, No. 1135.

CYLINDRICAL LIFE-BOAT.

MR. DOULL, jun., has exhibited to the Institution of Civil Engineers a model of a system, proposed by Mr. James Forbes, for lowering and raising ships' boats, and also the construction of a Cylindrical Ship-Life-Boat; which latter, it was contended, approached nearer than any other construction the qualities considered requisite for a boat of that class.

The Cylindrical Life-Boat was 30 feet long, 8 feet wide, and 2 feet deep, would carry with ease sixty persons, with provisions for a week, in the air-tight seats,—could not be upset,—or swamped,—could be pulled either end foremost,—was steered with an oar,—had extra buoyancy in water-tight compartments, and was so constructed, that a hole might be knocked into one or more divisions, without danger to the whole,—was fully stowed with masts, sails, oars, and everything complete so as to be always ready for use, on any sudden emergency.

When folded up it was perfectly cylindrical, and on reaching the water opened out, and could in a minute be made a stiff boat; and the dimensions could be modified to suit any vessel.

The apparatus for lowering the boats consisted of two davits, with tubular stems, down which the ropes passed, through sockets in the bulwarks, to a drum on which they were coiled, so as to be easily wound up by a wheel and pinion, with the exercise of very little power, and in lowering, a friction-break could be used with great advantage. By this means the boat would swing out very easily, as the davits could turn entirely round, and it would be nearly impossible that a boat could be swamped, in the heaviest sea, or under circumstances of the greatest difficulty. The cylindrical form, and its lightness of construction, would enable a boat of this sort to be put over the bulwarks by six men, without tackle of any kind, and by merely cutting a lashing when in the water, it would fall open; when all the stores, &c., would be found made fast within, and ready for use.

PORTABLE LIFE APPARATUS.

CAPTAIN MANBY, at the venerable age of 87, has added this invention to his numerous claims upon the gratitude and respect of society. It is intended for the rescue of persons on board vessels stranded on a lee shore, and the prevention of shipwreck, on an entirely new prin-

ciple; for producing the greatest possible increase of ranges, on small mortars, as well as on other guns, for the service of our national defences, in igniting the charge at the centre, contrary to the long accustomed usage of exploding at the top of the charges, from which an immense degree of its propulsive power is lost, and the powder wastefully expended. In an experiment with the invention, at Great Yarmouth, on July 5th, a man equipped with all the necessary appendages for this service, on his arrival at the spot, dismantled himself of his apparatus, stores, ammunition, &c., and in the space of two minutes loaded the mortar, pointed it at an object, and exploded it by a copper cap, and effected the range of 210 yards with an ounce of powder, and 245 yards with a charge of two ounces, conveying a line of sufficient strength to send off by it a rope adequate to perform any services for the saving of lives, or the prevention of shipwreck. Captain Carvitt, inspecting commander of the coast guard, was present, and the experiments were most satisfactory. The apparatus is manufactured by Mr. Moore, South Quay, Yarmouth, for six guineas. It should be added, that with it a man can ascend the rigging of a vessel, and apply it from the ship's top, so as to effect a communication with the natives of a forlorn country.

THE PORTLAND BREAKWATER.

A VERY interesting and novel engineering operation in the construction of this Breakwater is the building of a bridge across, or rather into, the sea. This is intended to connect two separate portions, one extending from the shore into the sea, about 1,900 feet, in an east-north-east direction; and the other about 6,000 feet in length, and isolated, the nearest point of which will ultimately be 400 feet from the inner portion. During the progress of the works, and until the pier-heads forming the ends of these arms are built, the necessary space for constructing them, and other contingent causes, will prevent the rough unfinished portion of the two arms approaching nearer to each other than from 800 to 1,000 feet. The stone with which the breakwater is formed is quarried by convicts; but the general execution of the same, requiring too much mechanical knowledge for such a class of men, is under contract. The stone (an admixture of rough large blocks, from six tons and under, mixed with a sufficient quantity of small ribble to fill the interstices) is tipped into the sea from railway waggons (without any attempt at regularity, with the exception of a due regard to a proper proportion of sizes), trains of which are hauled along the breakwater by locomotive engines. This mode of depositing the material renders its execution very cheap; and it is principally with a view of adopting this manner of construction on the outer breakwater that the bridge above alluded to becomes necessary. This is of course a timber structure, and, although only for what may be called a temporary purpose, is necessarily, both from its position and from the length of time it will have to remain, erected in a manner which would ordinarily be called permanent. The general depth of water at low water is about 57 feet, and the roadway being 25 feet above this level, it follows that the piles supporting it must be about

80 feet in length or height, and, as single timbers would be manifestly not obtainable, they are made like the masts of vessels, each weighing (when prepared with the necessary ironwork connected with it) about seven tons. The mode of fixing these in the ground is ingenious. They are shod with cast-iron shoes of Mitchell's patent, having a thread or worm upon them of a large pitch, which are screwed into the clay or shale by means of a capstan head, and bars fixed on the head of the piles. Each pile is supported in an upright position by very strong guys or stay rods, and upon these piles, which are in rows, 30 feet apart, the necessary superstructure for carrying three lines of railway and a horse-track is fixed, making a bridge of about 80 feet wide. The magnitude of the work and the speed with which it was executed were alike remarkable, the total length of 1,000 feet only taking about four months to do. The works are being constructed for the Admiralty, under the superintendence of Mr. J. M. Rendel, F.R.S. (President of the Institution of Civil Engineers,) engineer-in-chief; and Mr. John Coode, resident engineer.

NAVAL DRY DOCK AND HYDRAULIC LIFT AT PHILADELPHIA.

THIS Dock and appendages are described in the *Journal of the Franklin Institute* as being the largest in the world. The lifting power consists of nine sections, six of which are 105 feet long inside, and 148 feet over all, by 32 feet wide, and 11½ deep. Three of them are of the same length and depth as the others, but 2 feet less in width. The gross displacement of the nine sections is 10·037 tons, gross weight 4,145 tons, leaving a lifting power of 5,892 tons, which far exceeds the weight of any vessel yet contemplated. The machinery for pumping out the sections consists of two engines of 20, and two of 12 horse-power. In connexion with the sections (which form the lifting power of the dock), is a large stone basin, 350 feet long, 226 feet wide, and 12 feet 9 inches deep, with a depth of water of 10 feet 9 inches at mean high tide. At the head of this basin are two sets of ways, each being 350 feet long, and 26 feet wide. These ways are level, and consist of the bed pieces, which are three in number, and firmly secured to a stone foundation. The central way supports the keel, while the side ways receive the weight of the bilge. These ways are of oak, and are finished off to a smooth surface. On the top of the bed pieces or fixed ways, come the sliding ways or cradle, which are also 350 feet long and 26 feet wide, so constructed as to admit of being adjusted to the length of any vessel. The power directly applied in hauling up and pushing down ships is hydraulic, with a cylinder having a ram 15 inches in diameter and 8 feet stroke and a power of 800 tons, and hydraulic pumping engines attached. A steamship of 2,800 tons burthen was started by a power of 250 tons, and drawn thereafter by a power of 150 tons, 260 feet in six hours. "It will at once be seen," adds our authority, "that the capacity of this dock exceeds that of the stone docks at New York, Boston, and Norfolk combined; for united they can take but three vessels, while here, two of our longest war *steamers may be hauled* out on the ways, and two frigates

lifted on the sections. The advantages that must result from the facilities of repairing a vessel elevated into light and air over one sunk in a stone dock, are very great, and have only to be seen to be appreciated."—Quoted in *The Builder,* No. 514.

NEW BRIDGE AT ROCHESTER.

THE mode of constructing the foundations of a New Bridge at Rochester has excited considerable interest from its novelty and efficiency. It is the invention of Mr. Hughes. The bridge crosses the Medway with three arches—a central one of 170 feet, and an arch on either side of 140 feet span. The abutments and the piers (above low water-mark) are built of stone and brick in the usual way, and the arches are of cast iron. The roadway is designed to be 40 feet wide, and an opening bridge of 50 feet in width is to be made on the Strood side for the navigation of the Medway. The foundation consists of massive cast-iron bed plates, covered with concrete, resting upon a series of cast-iron cylinder piles, sunk through the bed of the river into the chalk, 46 feet below the concreted surface. These piles stand about five feet above the bottom of the river, and are enclosed by a curtain of cast-iron plates, serving to direct the flow of the current and to protect the piles from injury between ordinary and extreme low water level. This pier, as well as the other on the Rochester side, measures over the surface of the bed plates 70 feet between the points of the cutwaters, and 18 feet in width. The iron cylinder piles which support the bed plates are arranged in two rows of six in each and one pile at either end, carrying the points of the cutwater; they are 7 feet in diameter, and are formed of cylindrical castings 9 feet long, bolted together in succession as the pile enters the ground. The stones, gravel, chalk, &c., are excavated and entirely removed from the interior of the piles, and a concrete of gravel and Portland cement is substituted when the pile has reached a stratum sufficiently hard to support the weight of the bridge.

To sink these piles 40 feet into the bed of the river, and to effect the excavation where, at low water of ordinary tides, there is 5 feet, and a rise of upwards of 20 feet at high tide, was, under the circumstances which presented themselves here, a problem of no common character. In suitable soils (and this was at first thought to be one of them) the vacuum method, which was patented by the late Dr. Potts,* would assist in solving the question, if it did not succeed for the whole of the great depth of these foundations. An alternative presented itself of clearing the piles from water, by means of powerful pumps, driven by steam-engines of from 12 to 20-horse power, and working out the excavation when the bottom was laid dry. Such was the method followed on a magnificent scale by Mr. Brunel with the greater part of the cylinder piles forming the supports for the remarkable bridge carrying the South Wales Railway across the Wye, at Chepstow; and such suggested itself as the resource to be

* *Dr. Potts's invention* is described in the Year-book of Facts, 1848, p. 41.

called into action, after a few trials had proved Potts's method to be quite unavailable at Rochester. A careful examination of the ground forming the site of the Strood pier, during a very extraordinarily low tide, which occurred shortly after the attempts with the vacuum method had failed, and when measures were in progress for introducing water-pumps, brought out the fact, not previously known, that the bottom of the river there consisted of large rubble stones, intermixed with old but solid timber for a considerable depth, not less than six feet, as was then estimated, but which has proved to average 20 feet; and it became evident that any effort of pumping would cause a very large profitless outlay of money, and would result very much as would an attempt to make the surface of a sieve dry by withdrawing the water above it in the same way.

The principle of the diving-bell had been previously spoken of by many, in general and indefinite terms, as being probably useful in connexion with the system of iron cylinder piles; and it was now seriously discussed by the engineer and the contractors in all its forms, from the employment of divers in the helmet and caoutchouc dress to the use of the ordinary diving-bell, suspended inside the cylinder pile. It was sufficiently obvious that the cylinder pile itself might have the character of a diving-bell given to it by securely closing the top, and by forcing air into it until this had acquired a density sufficient to force out the column of water; but how to get the workmen into and out of a large iron vessel so closed up, how to carry off the stones, earth, &c., which had to be removed from its interior, and how to introduce the concrete and brickwork for filling it up, although equally obvious as conditions that must be satisfied (and satisfied, too, in a well ordered system to be carried into operation as any process usual in a properly regulated manufactory), were difficulties at first very imperfectly resolved.

Mr. John Hughes, as the engineer upon whom it devolved to devise and arrange the preliminary works and mechanical means for carrying out the contract which Fox, Henderson, and Co. had entered into, offered some suggestions to Sir W. Cubitt and to Sir C. Fox, which were favourably received; and they assigned to him the task of making the drawings and scheme complete, of constructing all the necessary apparatus, and of carrying it into operation. This duty he performed, and has described his contrivances in a paper read at the Institution of Civil Engineers in 1851. A technical account of the apparatus, which all who have seen it pronounce to be most ingenious, well considered, and effective, is already recorded in the proceedings of the Institution of Civil Engineers; but we may quote the address of Professor Airy, when President of the British Association, at Ipswich, as conveying a popular idea of it. The Astronomer Royal said—"Considerable importance, however, is attached by engineers to some of the processes lately introduced, especially that of thrusting down an air-tight tube or elongated diving-bell, supplied with air at the proper pressure, by which men are enabled to perform

any kind of work under water, in almost any circumstances, and in which men or materials may be transferred without disturbance of the apparatus by a contrivance bearing the same relation to air which a common canal-lock does to water."

That the working of this useful contrivance has been eminently successful, may be judged by the fact that the fourteen piles in the Strood pier of Rochester bridge were excavated 40 feet into the bottom of the Medway, and this was done without regard to the period of the tide or of the day. The pressure of air in the pile averaged about 18 pounds per square inch, the *maximum* being nearly 26 pounds, or equivalent to a depth of 60 feet of water. In the Rochester-pier thirteen of the piles were completed to a depth of 22 feet in the bottom of the river, and the *maximum* pressure during the execution was about 15 pounds to the inch. At Chepstow two of the cylinder piles were sunk 48 feet below the bed of the river by Mr. Hughes's arrangement, under the direction of Mr. Brunel, the *maximum* pressure being 28 pounds to the inch.

A writer in the *Times*, March 7, 1852, thus describes the sinking of the fourteenth pile for the Rochester-pier by means of the apparatus just noticed. This pile, standing on the bottom of the river, contained water to the same level inside as on the outside, which was seven or eight feet deep at the commencement of a flood tide. The air-pump, driven by a neat six-horse power portable steam-engine, being set to work, the pile was free from water in five minutes, the workmen then passed through the cages or air-locks and descended to the bottom of the river and proceeded with the excavation. Bucket after bucket was sent up through these air-locks until sufficient material had been cleared away to admit of the cylinder's further descent. The men were then recalled, the air let off, and, as the water rose, the cylinder, by its own weight, sank to a new footing. The process is thus repeated until the men have been enabled to carry the foundations to the necessary depth.

To say nothing of the complete safety under which the work can be carried on, and the small space of the waterway occupied during its progress, the advantages claimed for this system of foundations are their cheapness as compared with foundations formed by means of cofferdams, whether of timber or iron, and the security with which the superstructure can, without introducing timber piling, be raised on a bed of rock or of earth, known to be equal to the load it has to carry. Mr. Hughes's method of sinking these cylinder piles has added to these advantages the power to construct foundations under circumstances where they have hitherto been thought impracticable; the time required for accomplishing a foundation of given magnitude, and the cost to be incurred, are also reduced to a certainty capable of exact calculation.

THE GREAT BRITAIN STEAM SHIP.

This leviathian steamer has been refitted for the passage to Australia, with perfect success. Although many accounts have

appeared of her, the new arrangements render it necessary to recapitulate her fittings, &c.

The *Great Britain* is an iron screw steamer of 3,500 tons burden, and built of extraordinary strength. Five water-tight bulk-heads divide her into six compartments, and she is propelled by a nominally 500-horse power, but capable of being worked to a far greater amount. The engines are on the oscillating principle and with multiplying power, the usual jarring being entirely prevented by an ingenious arrangement. There are eight pumps in different parts of the vessel, besides the bilge pumps connected with the engines. A pipe from the boiler enables a jet of steam to be directed at a moment's notice to all parts in its neighbourhood; and a fire engine and fire annihilators are kept in different parts of the ship. There are ten life-boats, eight of them in davits, and the improved tackling renders it impossible for them to reach the water except on an even keel. Besides her power as a steamer, she has four masts, on which and her other spars nearly 13,000 yards of canvass may be spread. But her chief feature is the number of passengers she can accommodate—730 in all. They are divided in three classes, viz., after saloon, fore saloon, and second cabin. She is fitted with a deck-house extending from one end of the vessel to the other, forming a promenade of about 300 feet in length, reached by several flights of stairs, and enclosed by iron railings. In hot climates an awning will be spread over this promenade, and the draught of air caused by the forward motion of the vessel will render it a pleasant retreat in hot weather. The aft part of the deck-house is the saloon, 75 feet long, for first-class saloon passengers. It is well lighted by square windows, tastefully ornamented. At the stern end of the saloon is a boudoir with an ornamented skylight, in which the deck binnacle is placed. The arrangements for signals to the steersman and to the engine-room, are novel and excellent. Opposite to the after saloon is the steward's pantry, and there are 64 state rooms in the after part with elegant and commodious sleeping berths. To ensure an unfailing supply in the commissariat department, stores to the immense value of £7,000 are provided. In addition to the full quantity of water required there is a condensor, which will yield 2,000 gallons of fresh water daily. Several tiers of galleries run round the engine-room, from which an uninterrupted view of the machinery may be had. Forward of the engine-room is the fore saloon. The crew musters 130 hands, including officers, engineers, cooks, and stewards. The quantity of coal on board is 1,400 tons, chiefly Welsh, with some anthracite and patent fuel for experiment. From the Cape the Great Britain proceeds to Melbourne and Sydney, reaching Melbourne, as is expected, in 56 days from her departure from England; being one-half the average time of a sailing-vessel. She carries six heavy guns, and arms and ammunition for 100 men.

This noble vessel has made the passage from Liverpool to New York within thirteen days and three hours, having beaten the *Washington*, a paddle-wheel steamer, two days.

AMERICAN RIFLEMEN.

EUROPEANS are not acquainted with what has been done in America—the greatest country for rifle shooting in the world. The best book on the subject is that entitled "the American Rifle," by Mr. John R. Chapman, of Oneida Lake, N. Y. In Mr. Chapman's work, there are samples of American target shooting at 220 yards, the target being 20 inches diameter. In one sample, 10 shots can be covered with a man's hat around the bull's eye. Our crack rifle shooters employ telescopes on their rifles. Edwin Wesson, who is now mouldering in the dust, used to make fine rifles. We understand that since his death, the factory at Hartford, Conn., has broken down. Mr. James, of Utica, N. Y., makes splendid rifles, and there are a number of excellent rifle makers among us. We would call attention to Mr. Chapman's work. He says that a first-rate American rifle, with a telescope, will, in still time, throw all its shots, at 220 yards distance, into a circle of 1½ inches diameter, and at 440 yards into a circle of 8 inches diameter. No European shooting, we believe, can compare with this.* He advises the arming of select riflemen with telescopic rifles; a thousand of them would destroy an invading army of 30,000 men armed with muskets, before they could advance very far into the interior.—*Scientific American.*

RIFLE EXPERIMENTS BY CAPTAIN NORTON.

IN the *United Service Journal* it is stated (under the head of "Iron War Steamers," quoting from Sir Howard Douglas's book), that an oak plank three inches thick is proof against a musket-ball fired with four and a half drachms of powder at forty yards. The military musket is three sizes larger in the bore than the military rifle. Captain Norton's expanding shot, fired from the military two-grooved rifle, will pierce through an oak plank four and a half inches thick, at the distance of forty yards. This fact has been proved by using a charge of sporting powder of two and a half drachms. This is a great superiority of penetrating power in favour of the rifle, arising from there being no loss of power by windage, and the greater momentum of the elongated shot striking point foremost like an arrow. A solid shot of the same form will not carry point foremost during its flight, its base (being the heavier end) will struggle to lead, and this contention will derange the accuracy of its flight.

THE MINIE RIFLE.

MR. FAIRBAIRN has communicated to the British Association the following remarks on the Minié Rifle. Until of late years, the

* A letter from an officer serving in the Caffre War, in the *Times* of May 14, states:—"I have seen, I suppose, some 100,000 rounds fired from one firelock, and have seen the effect of Caffre fire to nearly the same amount; and I say that, first, an old flint musket, in the hands of a Caffre, who puts in about six drachms of powder, will kill a man at 800 yards; a regulation firelock, charged with four drachms and a half (the soldier spills half), ditto at 550; common rifle, charged with two and a half drachms, ball, conical, hollowed out at the base, 1,200."

gun-barrels for the army, and other descriptions, had to be welded upon mandrils, some of them formed by a bar of iron rolled upon the mandril, in a spiral direction, and then welded, by repeated beatings from the muzzle to the breech. Others were differently constructed, by welding the bars longitudinally, in the line of the barrel, and not in the spiral direction adopted in the former process. Now the whole is welded at one heat, and that through a series of grooves in the iron rollers, specially adapted for the purpose. This, with other improvements, has rendered the manufacture of rifles and other arms a matter of much greater certainty and security than at any former period. Admitting the advantages peculiar to this manufacture, it does not, however, affect the principle of the rifle itself, in which there is no alteration, but in every respect similar, even to the spiral grooves, which, Mr. Fairbairn believes, are not altered, but are the same as in the old rifle. This being the case, it has been a question of much interest to know wherein consists the great difference in the practice with the new rifle, as compared with that of the old one. It is not in the gun, and must, therefore, be in the ball, or that part of the charge which generates the projectile force. But, in fact, the improvement consists entirely in the form of the ball, which is made conical, with a hollow recess at the base, into which a metallic plug is thrust by the discharge. The plug is so constructed as that when driven into the ball, it compresses the outer edges against the sides of the barrel, and at the same time, forces a portion of the lead, from its ductility, to enter the groove, and to give the ball, when discharged, that revolving motion, which carries with such unerring certainty to the mark. In the practice which Mr. Fairbairn witnessed, with one of those rifles, on the marshes at Woolwich, the following results were obtained. Out of twelve rounds, at a distance of 700 yards, only one bullet missed the target, and the remaining eleven rounds were scattered within distances of about six inches to four feet from the bull's eye. At 800 yards three shots missed the target, and the remaining nine went through the boards, two inches thick, and lodged themselves in the mounds behind, at a distance of about twenty yards. The same results were obtained from a distance of 900 yards, and at 1,000 yards there were very few of the bullets but what entered the target. In these experiments, the end of the rifle was supported upon a triangular standard, and the greatest precision was observed in fixing the sight, which is graduated to a scale in the ratio of the distance, varying from 100 to 1,000 yards, which latter may be considered the range of this destructive instrument. — *Athenæum*, No. 1,299.

From the discussion that ensued, it appeared to be considered that the ball of Captain Miniè is far from being the best; for, after ten discharges, the barrel becomes clogged with lead, and the rifle cannot be loaded. The principal object is to prevent windage, and this has been attained in a simpler and more advantageous manner by different forms of elongated balls. The hollow ball without the iron

cap was stated to answer the purpose equally well, without leading the barrel. The advantage of the elongated or conical ball was stated to be, that when firing at a long range, the elongated form caused the ball to fly end foremost like an arrow, and to adapt itself to the parabolic curve described by its flight; whereas the end of a round ball does not follow the line of curvature, and at the latter part of its course the spiral motion imparted to it is at right angles to its descent.

AMERICAN SELF-LOADING REVOLVER.

THE *New York Courier* describes a newly invented Revolver and Self-loading Rifle made by Col. P. W. Porter, of Tennessee, and said to be capable of discharging fifty loads in a minute and a half. The rifle is a little over the ordinary weight, and, although a revolver, can be used as a single gun, the revolving agent being the guard of the gun instead of the hammer as in other revolvers. The guard, after revolving the cylinder, returns to its place, and firmly fastens by means of a spring in the stock. The cylinder, which is perforated with nine chambers on the exterior rim, turns in the breech, presenting in rapid succession each loaded chamber to the barrel for discharge. The part that comes directly in contact with the barrel is protected, first by the cylinder pressing firmly against it, and next by springing plates which catch and turn off any fire that might possibly escape through the junction. The ordinary trigger is used, and the rifle is discharged by percussion caps, and primes itself by an arrangement which presents itself to the hammer in succession. The caps are placed in a rim, and the hammer is on the one side of the gun. The nine chambers mentioned above being discharged, another cylinder, which may be kept in the pocket of the person using the gun, may be inserted in place of the one deprived of its contents, without a loss of more than three or four seconds, and nine additional discharges made in succession. Then, by placing over the top of the cylinder a flask which contains both powder and ball (or shot if necessary), the chambers are loaded by every revolution of the cylinder, so that the supply is only exhausted when the flask is empty, and in this manner fifty discharges are made in the short space of a minute and a half. The flask or magazine over the cylinder is water-tight, and affords good protection to the works it covers. The rifle can be discharged as long as the magazine containing the ammunition holds out, and by manufacturing a gun with proportionate arrangements, the magazine would consequently be larger, and capable of containing fifty or one hundred charges. Shot can also be placed in the magazine, and would, by changing the barrel, which is often done, be equally available. By this means the newly-invented gun will answer all the purposes of the fowling-piece, besides having the advantage over the latter of discharging about forty times a minute. The priming part is so arranged that the fire, instead of setting off the powder at the bottom of the charge, ignites it on top, but under the ball, thus burning all the powder

inserted instead of destroying some and throwing the residue out of the gun in its crude state, and having a greater resisting effect. The charge used is very small, yet this rifle has been found to carry a great distance, and in all experiments made, drives its bullets deeper into timber than any other tested against it.

NEW BULLET.

A New Bullet has been patented which promises to supersede the old Minie ball. The bullet, which externally is of the form of the Minie, is cast upon a cup of stout metal plate, tinned, the cap being formed pretty much on the principle of a copper cup. The tin and the lead unite together. The powder forces out the sides, and the tinned plate keeps them in that position, so as to ensure a perfect rifling. The sides, however, are capable of being made much lighter than the Minie; in fact, the entire bullet does not exceed the weight of the ordinary round ball. The experiments, which have been tried at a range varying from 200 to 1000 yards, were perfectly successful. The bull's-eye, about two inches in diameter, was struck several times at 400 yards.

COLOURS MOST FREQUENTLY HIT DURING BATTLE.

It would appear, from numerous observations, that soldiers are hit during battle according to the colour of their dress, in the following order:—Red the most fatal colour; the least fatal, Austrian grey. The proportions are:—Red, 12; rifle-green, 7; brown, 6; Austrian bluish grey, 5.—*Jameson's Journal*, No. 105.

ON TOOLS AND MACHINES.

The Rev. Professor Willis, F.R.S., has read to the Society of Arts, a paper "On Tools and Machines for working in Wood, Iron, and other Materials." The Lecturer commenced by some observations on the Great Exhibition, in which he did not consider machines concerned in the processes of manufacture to have been well represented. The Professor then exposed the fallacy of the contempt often entertained by practical self-taught men for those who are scientific and theoretical. No doubt the scientific man gives occasion for the charges which are brought against him: his object is to show in action the principles he is enforcing, and he therefore chooses as his examples machines of the simplest kind, exciting on that account the contempt of the practical mechanist. The exceeding jealousy existing between manufacturers of machines and tools is very much to be deplored. By preventing the open adoption of one another's improvements, a great impediment is put in the way of the perfection of machinery, whilst the secret piracy that so often takes place increases the jealousy and distrust. Combined with this is the intricacy of the patent laws, which prevent a step being taken in any direction without treading on another man's toes. In other practical sciences, this jealousy and distrust do not exist: the great discoveries of Faraday are at once adopted and followed up by his

fellow-labourers in the same path. Professor Willis then explained, by means of his admirable models, the principles of the action of the chief machines for "the shaping and confection of brute material." These models, or "geometrical diagrams," which are not only contrived, but also made by Mr. Willis, are those used by him in the illustration of his lectures as Jacksonian Professor to the University of Cambridge. Their frames are of card-board ingeniously jointed, so as to be exceedingly stiff when put together, and yet capable of very speedy and easy transformation. The working parts are of iron and brass, of simple forms, capable of being repeated in all the different models of the series. Professor Willis explained at length the mode of their construction, in the hope that it might enable others to make them. Shaping-machines are of three kinds, lathes, planing-machines, slotting-machines. The use of machines for shaping the parts of other machines originated with the watchmakers in the course of last century; and the first *manufacture* in which they were employed was that of Bramah's locks. This was followed by Brunel's block machinery. The lathe is the most ancient shaping-machine. The planing-machine was invented on account of the difficulty of making a flat surface in the lathe, the different velocities of the different parts of the surface preventing an advantageous cut being taken. The Society of Arts, in 1827, rewarded Mr. Clements for an ingenious lathe, in which this was overcome, by reducing the speed of the work as the tool travelled outwards; but the planing-machine was invented at the same time and superseded it. The slotting-machine originated in the tool invented by the late Sir I. Brunel for mortising the holes of blocks.

PHILOSOPHICAL INSTRUMENTS.

MR. GLAISHER, F.R.S., has read to the Society of Arts a paper "On the Philosophical Instruments and Processes of the Exhibition." Mr. Glaisher commenced his lecture by a comparison of the list of *desiderata* put forth by Dr. Playfair, with that of the instruments actually reported on by the jury of Class X., which showed that this department of the Exhibition was far from representing really the state of science. The several sections of that Class were gone through *seriatim*, the most worthy instruments in each having a notice more or less detailed. 1. Astronomical instruments. Simms's very beautiful and original contrivances for illuminating the wires of a telescope—Rosse's large equatorial; methods of illumination and their progressive improvement being explained by the aid of diagrams. 2. Electrical instruments. Shepherd's clock was spoken of in high terms as a real addition to horology. Mr. Glaisher detailed the American application of the telegraph to astronomical observations: in this method the observation is recorded, not by counting the seconds, and while still observing, noting in writing the times, but by simply pressing a stop. In the case of stations as far apart as Washington and Cincinnati, it was found necessary to determine whether any time was taken up by the passage of the electric fluid

through the wire, and it was discovered that it travels at the rate of 12,000 miles in a second. These experiments are still in progress. 3. Nautical instruments. A fine collection from America, by Ericsson; also, a highly ingenious compass, by St. John, in which the effect of local disturbance (from chain cable, &c.) can be distinguished from that caused by general magnetic change. The want of an instrument of this kind was said to have caused the failure of the Lopez expedition. 4. Surveying instruments. Very beautiful ones were sent from Russia and Austria. 5. Optical instruments. The telescopes were few, but good. Buraud's lens of rock crystal, Wray's fluid object-glasses, and Chance's 20-inch object-glass, were noticed with approval. It was hoped that some one might be found to share with Messrs. Chance the risk of failure in grinding this monster glass. The progress of England in this section is highly satisfactory. We are, thanks to the removal of the odious glass tax, fast rivalling Paris and Munich. The thermometers and barometers, the photographs and calotypes, and certain applications of the electrotype, by Mr. Hetherington Henry, were next noticed. In the former, the "maximum thermometer" of Negretti and Zambra was particularly praised, and one of the instruments was shown by the inventor. The lecturer explained the very ingenious barometers and pressure gauges of M. Bourdon. Photography is beginning to be applied to the recording of astronomical observations: this is due to Mr. Brooke. This apparatus was shown by diagrams, and its excellence borne testimony to by Mr. Glaisher.

LALANNE'S GLASS SLIDE RULE.

THIS improvement consists less in the substitution of Glass for the usual ivory, bone, or wood, than in the extension of its range of practical utility. First, the absolute number of scales is much greater than usual; secondly, there appears (for the first time) upon the face of the slide itself, a number of constant multipliers or "gauge points," as they are called, which will be found of the greatest practical value. The instrument is accompanied with a short Treatise by the Rev. William Elliott, in which the author not only gives a full explanation of the system of its construction and the manner of using it, illustrated by numerous examples, but a very complete account "of the theory of the sliding rule," in the *general*, which last portion is, of course, as applicable to other rules as to this of M. Lalanne.

NEW LEVELLING INSTRUMENT.

MR. W. GILLESPIE, of Torbanet-hill, Bathgate, has invented and patented an instrument called "the Inclinometer," for taking and adjusting the surface of slopes, railway gradients, the dip or rise of the bottom of water channels, and which is generally applicable to the execution of all levelling and sloping operations known in civil engineering. The instrument may be understood and applied by an ordinary labourer. It is constructed in the form of a parallelogram.

The bottom parallel being placed upon any slope, the under parallel necessarily represents to the eye the precise amount and direction of that slope—more especially since direct means are taken to compare it with the true horizontal level. For, to measure the amount of slope, an additional limb or parallel is hinged, at one end, to the top bar or parallel of the parallelogram. From the other or free end of this addition, depends a plummet or pendulum, by a cord or wire passing vertically down the graduated front of an additional side bar or limb of the parallelogram, fixed at right angles to the moveable parallel or spar above. This moveable limb being raised from the parallel position in which it reposes upon the upper bar of the Inclinometer, to a position perfectly horizontal according to the plummet, and, if necessary, fixed in that position by a sector or quadrant with loose screw attached; the space intervening betwixt the two top bars, as marked off on the graduated or vertical side, is the rate of slope sought to be ascertained. The bottom and top parallels being thrown from the due level in trying the slope, and the due level restored in the case of the move-spar, its deepening or vertical limb thus shows the difference—the two constituting, in fact, the elements of a rectangle, or two of the sides of a parallelogram, the same as the instrument itself, only applied to the true level, whilst the instrument is applied to the slope. The difference thus evinced must therefore be the exact rate of slope, or deviation from the level; and the instrument is capable of being fixed to that rate of slope by screwing to the immoveable top bar the sector attached to the moveable one.—Abridged from the *Scottish Press.*

IMPROVED HELICOGRAPH.

A PAPER has been read to the British Association, "On Penrose and Bennett's Sliding Helicograph," communicated by Professor C. Piazzi Smyth. The author observed: "I was led, during my researches on the subject of the refined curves of the Greek mouldings and ornaments, to consider whether it would be possible to contrive some method of describing the volutes and scrollwork at once more ready and more satisfactory than the tiresome approximations, by means of circular ones, which have generally been used. I invented an instrument for this purpose, called the Screw Helicograph. This instrument has been elaborated into the improved form now exhibited. By simply turning round the graduated ring within the square frame, this instrument is enabled to draw in pencil or ink any form of the equiangular spiral from the circle to the straight line; and, by alterations in the position of the pen, or of the centre, with respect to the guide bar, certain variations may be obtained. Also, either a parallel line to the first may be drawn by a simple adjustment of the pen, or a duly converging line, by bringing the whole frame nearer to or farther from the centre. Expressing the ratio between two spiral radii at an interval of 360° (*viz.* $a^2\pi$) by the term '*spiral ratio,*' it appears that curves drawn with this instrument with spiral ratios less than 8 or 10 to 1 are fitted for volutes and

scroll-work, and those which are drawn with higher ratios for the outlines of vases and other such figures where a *gentle variation of curvature* is desired. This quality is insured from the property of the curve that the radius of curvature is proportional to the length of the arc. For figures where great energy is required, curves of a different nature are more suitable, but no curves appear to surpass these in sweetness of sequence."

THE PANTOGRAPH.

THIS cutting and carving machine, whereby copies of all sorts of workmanship in wood, stone, or metal, and on a scale larger, smaller, or the same, compared with the originals, may be turned out with great rapidity, has been patented by Mr. Searby, and a Company has been formed for the development of its capabilities. Acting on the principle of the slide-rest or floating bed, and directed by the Pantograph, the machine is moved with such facility and exactness in all the directions of the cube, under a fixed tool or tools, that it is capable of producing, in cutting, carving, or engraving, a fac-simile of almost anything presented to its operation. According to the statements, "the hardest substance offered no impediment to its powers: it can turn out copies of any shape you please. It will engrave seals to any pattern; turn out an exact copy of the Medicean Venus or the Greek Slave; furnish blocks to the calico printer, the floorcloth manufacturer, the paper-stainer, and the letter-press printer; execute monumental tablets and architectural ornaments; form saw-handles; cut names and sign-boards, or do anything else which requires any sort of shape or impression to be given to the hardest materials,—performing that which appears the most difficult or delicate feat, with as much despatch, exactness, and finish, as the easiest and least pretending. We have seen, for example, two initial letters which were cut in less than one minute, but which, we suppose, it would take a skilful stonemason the best part of an hour to chisel out only half as well. The utility of the machine may be inferred from its applicability in the single department of saw-handles. One of the Company's machines, managed by a man and a boy, will produce 300 handles a day from one cutter; but, as each machine may have three cutters or more, it is obvious that the entire trade might be supplied by a few machines. The machine is cheap, and may be wrought with ease by any description of power, from hand to steam.—*Builder*, No. 508.

COUCH'S PATENT ROCK-DRILLING MACHINE.

A ROCK-DRILLING Machine, now at work on Taylor's Ledge, Somerville, United States, is thus described by a Boston journal:—"The machine consists of a small upright boiler, placed on wheels so as to be easily moved from place to place; to which is attached a small steam-engine, so contrived that it can be set in any required position. The piston-rod of the engine is made hollow, and through this and the cross-head the drill passes perfectly free. In the cross-head of

the engine is placed a simple apparatus for seizing, turning, and throwing the drill. The motion given to the drill is the same as in hand drilling, where the "churn-drill" or "runner" is used. The machine strikes from 150 to 200 blows per minute, according to the activity of the steam power; and in the peculiarly hard rock of the ledge on which it was at work, it settled a 3-inch perfectly round hole at the rate of about half-an-inch a minute. By computation this machine, it is said, will do from sixteen to twenty men's work, at an expense of from three to six dollars per day. The probable cost will be short of a thousand dollars. It is said to drill a horizontal hole as easily as a vertical one. Indeed, this is one material advantage of the machine, that it can drill at any angle, from horizontal to vertical."

A PERFORATING MACHINE.

The tunnel of the Troy and Greenfield Railroad, through the Hoosac mountain, is made with one of Wilson's stone-dressing machines. This machine is worked with a steam engine, and will enter from 6 to 15 linear feet per day. The cutters are circular plates of cast-steel, of 14 inches diameter, half-an-inch thick, and ground, with a bevil on each side, to an edge. They are placed on the rock, at the angles of about 45 degrees, and roll over the surface with great rapidity. The edge is pressed into the rock with great force, and acts as a wedge, prying up and throwing off the rock in a surprising manner. A block of granite, 10 feet long and 4 feet wide, was placed on a carriage, and submitted to a single cutter, gauged to cut 2 inches from its surface. It passed over the entire stone in 22 minutes, and cut off 1,600lbs. of rock, leaving the same as smooth as any hammer-dressed stone.—*Albany Argus*, U. S.

TRIALS OF ANCHORS.

The following tabular result of four series of experiments made at Sheerness, in the past year, affords a correct idea of the holding qualities of the several competing Anchors:—

First Series of Experiments. At the Dockyard.

Trotman beat	Honiball beat.	Mitcheson beat.	Rodgers beat.	Aylen beat.	Admiralty (new) beat.
Rodgers' Ex. Prize Admiralty (new) Honiball (Porter's) Rodgers' stream kedge Admiralty (new) 6 cwt. heavier.	Aylen Mitcheson	Isaacs' (American) Admiralty (new) Rodgers' stream kedge G.W.Lennox Aylen.	Aylen. Admiralty. (new)	Admiralty (new) Isaacs.	G.W.Lennox

Second Series of Experiments. On the Beach, at Garrison Point.

Trotman beat.	Honiball beat.	Mitcheson beat.	Rodgers beat.	Aylen beat.	G.W.Lennox beat.
Aylen. G.W.Lennox Honiball. Admiralty (new).	Isaacs' (American) Mitcheson.	Rodgers' (E. P.)	Aylen's (2nd trial).	Rodgers' (1st trial).	Admiralty (new.)

Third Series of Experiments. At Black Stakes, in the Medway.

Trotman beat.	Rodgers beat.	Mitcheson beat.	Aylen beat.	G. W. Lennox beat.
Aylen. G. W. Lennox.	Admiralty (new).	Rodgers' (E. P.) Honiball. Mitcheson.	G. W. Lennox.	Isaacs.

Fourth Series of Experiments. Steam Trials at the Nore.

Trotman beat.	Mitcheson beat.	Aylen beat.	Rodgers beat.
Admiralty (new). Mitcheson (1st trial).	Honiball. Isaacs (American) Trotman (2d trial.) Lenox.	Rodgers (at 2d trial).	Aylen (1st and 2d trials).

In a supplementary trial, the canting properties of the several anchors were thus ascertained. The whole of them, eight in number, were placed in a line on their stock end, and a 36 fathom length of chain was successively bent on to each, with tackle and running gear attached to it. Upon this a party of marines hove smartly until the anchors canted into biting positions. In this instance the American anchor achieved a triumph, turning over immediately the strain was applied. The distances dragged by each of the others before canting were very trifling. Aylen's was drawn 22 inches, which was the greatest of any. In this respect, therefore, there is comparatively little difference between them. The officers present evidently evinced much interest in these important experiments, from which much practical information of the present state of the anchor art may be gained.

Next, the anchors originally tested at Woolwich with the usual proof strain, and subsequently experimented with at Sheerness to ascertain their holding powers and other qualities, were brought into the Anchor-testing room at Woolwich Dockyard, to be broken in the presence of several officers and scientific gentlemen.

The first anchor placed in the testing frame was one of Lieutenant Rodgers' patent anchors weighing 19 cwt. 8 lbs., the usual testing strain of that weight being 19⅞ tons. On the 20 tons strain being applied, the deflection was a quarter of an inch, and it began to crack at 45 tons, and again at 68¼ tons, 70½, 71¾, 72, 73, and broke its shackle at 73½ tons, which completed its trial.

Mr. Mitcheson having declined to have his anchor broken, one of Messrs. Brown and Lennox's anchors, weighing 20 cwt. 3 qrs. 14lbs., was placed in the frame, the usual proof strain being 21½ tons. On 20 being applied it deflected 1-16th of an inch, and it cracked at 44½ tons, and broke at 47 tons, the shank being broke even across at 2 feet 4¾ inches from the crown.

Mr. Isaacs' American anchor, weighing 21 cwt. 0 qr. 14 lbs., was then placed in the frame, the usual proof strain being 21¾ tons. On 20 tons being applied it deflected 3-16ths of an inch, and cracked at 58 tons, and again at 61, 62, and broke at 63 in the shank, near the crown.

Mr. Trotman's anchor, weighing 21 cwt. 1 qr. 10 lbs., was next placed in the testing frame, and on 20 tons being applied, it deflected 11-16ths of an inch, and cracked at 51½, and again at 53, and broke at 53½ tons, in the shank, 2 feet 4 inches from the crown. It was not intended to break Mr. Honiball's (late Porter's) anchor, its principle being so similar to Trotman's, which was made as an improvement upon it; but in consequence of Trotman's being the first made on his plan, and the peak found to press too much on the shank, it was decided that Mr. Honiball's should be broken. On being placed in the testing frame, it began to crack on the application of 54 tous, again at 59½, 60½, 63, 66, and broke at 75½ at 2 feet 3½ inches from the pin in the crown. The upper arm broke at the same moment; a proof of the equal strength of both parts of the anchor.

The trial concluded at half-past four o'clock P.M., by breaking one of the Admiralty anchors, which began to crack at 40½, again at 48½, 50, 51½, 52½, 53½, 54, 54½, and the arm came out of the crown at 56½.

The breaking of Mr. Aylen's anchor next took place; when it deflected five-eighths of an inch on 20 tons strain being applied. It cracked at 44, and broke in the shank, near the crown, at 47½ tons.

The following gives at one view the final result of the experiments, the breaking of the anchors, and the time occupied in breaking each; and we may here observe that the labours of the committee have been repaid in the feeling of satisfaction of having rendered to the maritime interest of this country, and to humanity generally, a great boon in an improved and truly efficient anchor, formed purely on scientific principles worthy of the age in which we live. It is impossible to overrate the importance of these experiments (the first series of which have been brought to a close), their tendency being the preservation of life and property.

Anchors.	Weight.			Proof Strain.	First Crack.	Broke.	Time in Breaking.
	Cwt.	qr.	lbs.	Tons.	Tons.	Tons.	Minutes.
Lieutenant Rodgers's...	19	0	8	19⅞	45	73½	21
Mitcheson's	21	0	0	21⅝	—	—	—
Brown and Lennox's...	20	3	14	21	44½	47	7
Isaacs's	21	0	14	21¾	58	63	10
Trotman's.................	21	1	10	21⅞	51	53½	18
Honiball's	20	3	7	21½	54	75½	42
Admiralty's	20	2	6	21½	40	56½	26
Aylen's	21	1	0	21¾	44	47½	6

PRINTING MACHINERY.

Mr. Augustus Applegath, of Dartford, Kent, has patented certain improvements: in which he claims—"The division of the form of type upon two cylinders, whether such cylinders are placed horizontally or vertically, or however combined with the impression cylinder and other parts of a printing-machine. Also, the galley-chase for retaining the type. Likewise, the use of taper type having sides tapering to a larger angle than that given by the cylinder from which it is imposed. And further, the double action by arranging two impression cylinders to act against the type cylinders, whereby two complete impressions are obtained at each revolution of the type." For details, with illustrations, see the *Mechanics' Magazine*, No. 1510.

CLEANSING MACHINERY.

An apparatus for Beating, Brushing, Scouring, and Drying Carpets has been patented by Mr. Horn, of Belgrave-street, Pimlico. The carpet is fixed on rollers, and made to pass between spring whips and revolving brushes. In purifying feathers, wool, &c., dust is first removed: they are then subjected to steam, and dried by heat.

IMPROVED LUBRICATOR FOR MACHINERY.

M. B. Coquatrix has patented a Lubricator, consisting of a box containing the oil, from the bottom of which a tube descends directly on to the bearings; and on the top of this tube a boss is cast, with a screw thread turned in it, into which a thumb key, with a conical point, is screwed, so that the annular aperture formed in the tube by the insertion of the key can be instantly closed, when the machinery is at rest. By raising the key by unscrewing, the conical point serves to regulate the supply from one to as many drops per minute as may be required. In fitting on this lubricator, it is only necessary to take off the old and insert the patent one instead.

IMPROVED COUPLING.

A Coupling has been patented by Messrs. Gale and Fensom, of Homerton, for joining the two ends of bands or straps used for driving machinery. It consists of a gun-metal plate, covered with gutta percha, with two studs screwed throughout, to receive two screws

with countersunk heads, for bringing down a top plate of the same metal. By passing the studs through two holes in each end of the band, and screwing down the top plate, a powerful grip is obtained throughout the whole width of the band, without causing any obstruction in passing over or under rigging, friction pulleys, &c.

IRON MANUFACTURE.

MR. JONES, of Bilston, has patented a peculiar method of constructing Furnaces with a view to preserve them as much as possible from the action of the fire. The claims are, for the use of water, or other cooling liquid, supplied by proper troughs, to the doors, dampers, flue jamb plates, the bridge plates, and back wall plates, of puddling, boiling, or heating furnaces, and also for a tank under the bottom plate for cooling and preserving them. Likewise the employment of a flue for carrying off the heated air, sparks, and products of combustion, from a refinery furnace; and the economization of heat from the latter, by passing the heated air from the same through the flues of or around a steam boiler.—*Mining Journal.*

SILESIAN IRON.

AT the recent Silesian Exhibition of Arts and Manufactures, the most extensive display of Iron, in all the stages of its manufacture, was sent from the numerous forges or *Hutten* of Count Renard, who alone occupied a large portion of the basement of the building. The quality of the metal produced at his works has secured it a local reputation; though other establishments, as the Laura Works, at Beuthen, produce iron in bar and the larger forms in greater quantity. The Renard Works are unrivalled in the finer sorts; and of hoop iron, nail-rods, wire, cast iron for cooking vessels, steel in many varieties, especially forged steel of the finest quality, there was a most abundant supply. Sheet iron was exhibited from these works of such a degree of tenuity that the leaves can be used for paper. A bookbinder of Breslau has made an album of nothing else, the pages of which turn as flexibly as the finest fabric of linen rags; perhaps, books may hereafter be printed for the tropics on these metallic leaves, and defy the destructive power of ants of any colour or strength of forceps. We have only to invent a white ink, and the thing is done. Of the finest sort the machinery rolls 7,040 square feet of what may be called leaf iron from a cwt. of metal. In point of price, however, the Silesian iron cannot compete with English; much is still smelted with wood, and the coal and iron districts lie at great distances from each, so that much capital is consumed by the conveyance of fuel to the works.—*Times.*

IRON LIGHTHOUSE IN THE UNITED STATES.

A LIGHTHOUSE on Carysfort Reef, Florida, has been completed by the Topographical Bureau, Merrick and Towne, of Philadelphia, engineers. It is built on piles arranged upon the angles and centre of an octagon; the heads of these piles are united by iron ties,

and on this rise courses of iron pillars, and a strong central column from the centre foundation to a level with the top of the upper series of pillars; from which central column there radiate, at proper levels, iron girders of great strength, which, added to the horizontal ties extending from one pillar to another, form a combination so compact and stiff that no force of the wind, it is supposed, will ever disturb it. For the residence of the keepers of the light, a cast-iron dwelling of a circular and conical form is fitted to the above described frame-work of pillars, ties, &c., at a point of 35 feet above the level of the reef, and 20 feet above the highest tides.

The dwelling consists of two stories. The lower one, being 8 feet in height, and 40 feet in diameter, is designed for the deposit of stores, the kitchen, &c. It is fitted with 8 windows, and 16 bulls' eyes—the former for air, and the latter for light. It contains six iron tanks for water and oil. The upper story is divided into six rooms, with a hall in the centre to allow a free ventilation in all the apartments. There is a door at each end of the hall, and a large window in each room. Surrounding this story is a gallery, exterior to the house, 5 feet in width, where the keepers may exercise.

From the centre of the hall rises a spiral staircase to the top of the structure. This staircase is inclosed by an iron cylinder, the whole weight of which rests upon the roof of the dwelling-house. On the top of the structure is placed the watch-room and lantern, or light-room, fitted to contain a Fresnel apparatus of the largest size, that will produce a light of the highest power. The diameter of the structure at the base is 50 feet, and 20 feet at the level of the watch-room floor. The height of the entire work above the surface of the reef is 127 feet, and the height of the centre of the light 115 feet.

IMPROVED SOLID BRASS TUBES.

MR. G. F. MUNTZ, jun., of Birmingham, has patented a method of manufacturing Solid Brass Tubes, without joint or solder, for flues of locomotives, &c. The composition preferred by the patentee is sixty parts of best refined copper and thirty-eight parts of good zinc; and the first process is the casting of a tube shorter than required, in a peculiarly-formed mould. This tube is then brought to a temperature at least equal to boiling water, and its interior rinsed with a mixture of lime in water, with common salt. It is then, at a red heat, passed through a pair of flat rollers, similar to those used for rolling flat bar-iron, which produces a bar of brass with rounded edges, but with a flat orifice throughout—the lime mixture preventing the adhesion of the top and bottom surfaces; and in this rolling the casting attains a considerable increase in length. One end of this is then sufficiently opened by the workman with a suitable tool to a distance in length of about 6 inches; and, being again brought to a red heat, is passed through grooved rollers over a proper-shaped mandrill. A tube, oval in section, is the result. Having again been passed heated through cylindrically grooved rollers over a circular mandrill, a finished tube is produced.

COATING AND ORNAMENTING ZINC.

A PATENT has been taken out by Mr. F. H. Greenstreet, of Albany-street, for Coating and Ornamenting Zinc Surfaces, by means of acids alone, or in combination with other matters. The solution may be applied by sprinkling, dabbing, spreading, or marbling; and the surfaces are capable of further ornamentation by painting. Muriatic acid, diluted with water to about 1·114 specific gravity, gives a light ash colour; chrome yellow, with the same acid, a yellowish grey: Saxony green, mixed gradually with the acid to a paste, and stirred until effervescence ceases, produces greenish iron grey: white lead with the acid, or Kremintz white, gives a grey coating: the acid with sulphur produces a yellowish white. Butter of antimony gives a black colour: when mixed with the other pigments it does not affect them, but makes a good groundwork. The surfaces having been coated, should be protected by a coat of varnish. Copal may be used, but the patentee prefers a preparation of wax, as effectually preventing oxidation.

SOLDERING METALS.

M. DERODE, of Paris, has patented a new process for uniting cast-iron to cast-iron and other metals, and for uniting other metals together. He claims—1. The uniting of metals by the agency of electricity (either magnetic or electro-galvanic), with the usual scouring process, and with the addition of ordinary heat. 2. The combining electric agency (either magnetic or electro-galvanic) with the scouring process. 3. The application of an electric multiplier to the scouring process and to the Soldering of Metals.

CASTING IN BRONZE.

MR. ROBINSON'S new process of Casting in Bronze, was exhibited to perfection in June last. By this method, works of great size and importance are moulded entire, instead of piecemeal as of old. Every multiplication of the acts by which a work of Art is to be transferred from its original Art-language into another increases, it will be obvious, the risk of some sacrifice of the author's intentions or proportions:—so that Mr. Robinson's new method, by which a single act of translation is made to suffice, is at once a simplification and a most valuable improvement. The first experiment on a large scale was made with Mr. Behnes's Peel statue for the town of Leeds, and the success was such as to establish the process for future great works. In the present case, the subject was the fine statue, upwards of ten feet in height, which Mr. Baily has modelled for Sir Robert's native town, Bury, in Lancashire. Of old, the casting of large pieces, even when such works were divided, took place in pits dug to contain the mould,—and the legs and trunk would have received the burning stream which was to harden to immortality within them in upright posture. On the present occasion, a huge iron case, strongly bound and rivetted, had been built on the surface of the floor, of dimensions to receive the full-length figure in a horizontal position. Close

at hand glowed and roared the huge furnace in which the fusion of metals was, under the compelling power of a heat intensified into almost invisibility, for hours going on. When this process of fusion was accomplished, the mixed metal, to the weight of more than two tons, was received into an iron cauldron, and swung by machinery to the case which enshrined the mould. In the black sand that formed the roof of this case and of the mould there was one great vortex for the reception of the flaming material,—and from this, channels running in all directions to convey it horizontally to every part of the figure at once. Here, the liquid flame was skimmed:—and after a few minutes of breathless pause—under the influence of strong excitement to the spectators, and of deep anxiety no doubt to those more immediately concerned—the final signal was given. The cauldron was turned over at the mouth of the vortex by the machinery from which it swung,—and in thirty seconds by a stop-watch, the Bury "Peel" was cast! The thing was like the creation of an enchantment. The workmen at once proceeded to the task of knocking away and uncovering; and the result was a cast of surpassing beauty—almost perfect from the mould itself—and scarcely needing the chaser's hand.—*Athenæum*, No. 1288.

BAGGS' PATENT MACHINERY FOR CRUSHING GOLD QUARTZ AND METALLIC ORES.

THE principle of applying the direct action of steam or of atmospheric pressure to the movement of a forge hammer has already formed the subject of various patents long since expired. The improvements, however, which have been made in the construction of this description of engine within the last few years have invested it with a certain degree of novelty; and it is in the application of the principle here named to a new and useful purpose, and in the details whereby that application is rendered practically efficacious, that the present invention consists. Wherever rollers and ordinary stamp-heads are employed for crushing ores, a separate and independent steam engine, with its shaft, fly-wheel, and connecting gear, is necessary to produce motion; but here the apparatus is complete in itself.

The most striking feature in this engine consists in the "regenerator," composed of wire net, placed side by side until the series attain a thickness of 12 inches. Through the almost innumerable cells formed by the intersection of these wires the air must pass on its way to the working cylinder, and is so minutely subdivided that the particles composing it are brought into close contact with the metal which forms the wires. Thus, the side of the regenerator nearest the working cylinder is heated to a high temperature. Through this heated substance the air must pass before entering the cylinder, taking up, as demonstrated by the thermometer, about 450° of the 480° of heat required to double its volume. The additional 30° are communicated by the fire beneath the cylinder. The air thus expanded forces the piston upwards, opens the valves, and the

imprisoned air, heated to 480°, passes from the cylinder, and again enters the regenerator, through which it must pass before leaving the machine. The side of this instrument nearest the working cylinder is hot, but the other side is kept cool by the action upon it of the air entering in the opposite direction at each up-stroke of the pistons. Consequently, as the air from the working cylinder passes out, the wires absorb its heat so effectually that, when it leaves the regenerator, it has been robbed of it all except about 30°. In other words, as the air passes into the working cylinder, it gradually receives from the regenerator about 450° of heat; and as it passes out this is returned to the wires, and is thus used over and over, the only purpose of the fires beneath the cylinders being to supply the 30° of heat we have mentioned, and that which is lost by radiation and expansion.

GOLD REFINING.

MOST of the native gold brought to the American mint for refining, contains silver, from which it must be separated before it can be supplied with the uniform proportion of alloy required by law in gold coin. For this purpose, the process now in use throughout the world is to melt the gold to be refined previous to coining it, with two to three times its weight of silver. It is then granulated and exposed to the action of hot nitric or sulphuric acid, which dissolves out nearly all the silver, both that in the native metal and that added by the refiner, and thus leaves the gold in nearly a pure state, and ready to receive the necessary portion of alloy required in the gold coin. It will be seen at a glance, that allowing a million of California gold to weigh 53,250 ounces, or nearly two tons, it would require nearly six tons, or 161,250 ounces of silver, and worth about 190,000 dollars, to be kept constantly on hand to work it. The desideratum is, therefore, to find some process of working the gold by which this great outlay of silver may be prevented, and by which greater celerity may be effected; both of these results, the inventors of the two following processes allege they have obtained. They state:

"In the first the argentiferous gold is converted into the chloride by the action of nascent nitro-muriatic acid generated by the reaction of sulphuric acid upon a mixture of nitrate of soda and common salt, or by other equivalent means. The silver contained in the native gold is also converted into the chloride by the same chemical re-action, and it is prevented from incrusting the gold by the more intense affinity, and the agitation produced by a jet of steam, which is constantly being forced into it. The gold is next precipitated in the metallic state upon the chloride of silver, by means of pulverized copperas. After washing the precipitate of gold and chloride of silver, the latter is reduced to the metallic state by the reaction of zinc and dilute sulphuric acid; and, subsequently, the silver is dissolved out by means of nitric acid. From the nitrate of silver obtained above, the metal in the pure state is precipitated in the usual way, by the reaction of zinc, and dilute sulphuric acid.

"In the second patent referred to, the design of the invention is to avoid the use of chloride in the first part of the process. The argentiferous gold is first melted down with zinc or other metal baser than silver, from which alloy the baser metal may be dissolved out by dilute sulphuric or other cheap acid, and the bullion pulverized; or an alloy of great brittleness made, which may be easily crushed or broken down by mechanical means, so as to fit the gold bullion

for the direct action of nitric or other acid. The inventor states, that he first mixes the argentiferous gold with twice or three times its weight of zinc, melts and stirs well the alloy, and then granulates the same by pouring it into water. The alloy thus obtained, is next treated in wooden vessels lined with lead, with dilute sulphuric acid, which removes the zinc, and leaves the argentiferous gold in a finely-divided pulverulent or spongy state. In this second operation, heat is not required, and but little more sulphuric acid than will be necessary to form the sulphate of zinc.

"Third. The argentiferous gold thus reduced to a spongy state, and still containing the silver untouched by the reagents used, is treated with hot nitric or sulphuric acid (the sulphate of zinc having been first entirely removed by washing), by which the silver is entirely removed, and to be obtained in a metallic state, as in the former process, or in the usual way. Finally, the operation is finished by cupelling the gold, or melting it with such fluxes as borax, nitre, &c., and casting it into bars."—*American Patent Office Report*, 1850-51.

HUNT'S PATENT GOLD-WASHING MACHINE.

THE Machine must be placed perfectly level, taking the advantage, if possible, of any stream of water near the gold or other mineral to be washed. If a regular stream cannot be obtained, the water must be supplied by artificial means. In the event of there being a difficulty in obtaining water, the machine is so constructed as to use the same water a great many times, until it becomes too much charged with muddy matter to be any longer fit for use. The mineral matter to be washed must first be passed through a sieve, the holes or mesh of which are one third of an inch square, what remains on the sieve must be examined. The sifted matter must then be put into the receiver until it is full within one inch and a quarter of the bottom of the water-escape, taking care to have it placed level on the pierced copper plate. The force-pump, having been filled with water in order to counterbalance the lift, must then be put in quick motion, the perpendicular stroke to be about one inch and a quarter, which causes the whole of the matter in the ore-receiver to be set in motion, the gold or other minerals, according to their specific gravity, falling to the bottom. The grains of gold which are sufficiently small to pass through the pierced copper plate at the bottom of the ore-receiver will be found in the tray marked, the larger grains remaining on the pierced copper plate; the gold on the plate and in the tray below can be removed at any time, but as some sand will be mixed with the gold it must be re-washed, this can be done at the end of the day's work, or when sufficient quantity is accumulated. The tray under the ore-receiver should be frequently examined, and emptied when full. The time required to keep the force-pump in motion will be about one minute and a half for each charge, when the gold will be precipitated. The ore-receiver must then be raised, by means of the screw-handle, as far as a hole drilled in the under part of the screw, when a small iron pin must be introduced to keep the ore-receiver in its place until the refuse is removed. This is done by opening the falling-door in the side, and using the scraper, taking care to leave at least from half to three-quarters of an inch of sand or mineral matter on the plate, so as to prevent any of the gold being lost that may not be perfectly

precipitated; the door is then shut up, and the receiver or sieve screwed down to its place, being kept there by a pin of iron. A tube must be removed when water is plentiful and not required to be used over again, in which case, the hole where the small end enters must be shut by a slide fixed inside.

It is well known that by far the greatest quantity of gold is found in very small grains, and, by an imperfect mode of treatment, much of it is carried away in the washing, and it is most probable that, by the use of this machine, much of the fine gold which has thus been lost could be recovered with great advantage.

The Patentee has been for many years Concessionaire and Director of the ancient mine of Pont Pean, near Rennes, in France. After the auriferous sand to be operated upon has passed through the sieve of three square holes to the inch, as before mentioned, one active man can wash about six hundred pounds an hour, and presuming each hundred weight produced only twenty grains of gold, it would be equal to about two ounces a day, of eight hours working.

CONSUMPTION OF GOLD.

In reply to an oft-asked question, in consequence of the apparent "glut of Gold," Mr. Hunt has replied, in a lecture delivered by him to the Society of Arts: "Let it not be forgotten that the exportation of coin from England is rapidly increasing, and the English sovereign is becoming more extended as a medium of exchange. Formerly the Spanish dollar passed everywhere, and now the English sovereign is taken as current coin over three-fourths of the globe: and its exportation keeps pace with the importation of raw gold. From November 1850 to June 1851, the Bank of England issued 9,000,000 sovereigns, being at the rate of 18,000,000 a year; and so great is the demand for our gold coin that Sir John Herschel informs us since November last they have coined at the Mint 3,500,000 sovereigns and half-sovereigns, and the rate of production can scarcely keep pace with the increasing demand. This must have a material influence in maintaining that stability which is desirable in our standard value. In Birmingham, not less than 1,000 ounces of fine gold are used every week, and the weekly consumption of gold-leaf is as follows:

	Ounces.
London	400
Edinburgh	35
Birmingham	70
Manchester	40
Dublin	12
Liverpool	15
Leeds	6
Glasgow	6
Total	584

Of which an eminent gold refiner states not one-tenth part can be *recovered. For gilding* metals by the electrotype and the water-

gilding process, not less than 10,000 ounces of gold are required annually. One establishment in the Potteries employs 3,500*l.* worth of gold per annum, and nearly 2,000*l.* worth is used by another; the consumption of gold in the Potteries of Staffordshire for gilding porcelain and making crimson and rose colour, varying from 7,000 to 10,000 ounces per annum. The consumption of gold and silver in Paris has been fairly estimated at 14,552,000 francs a-year. The wear upon gold coin in circulation is about four per cent. per annum; and from this knowledge and the foregoing details we may deduce the fact that nearly 2,000,000*l.* a-year is necessary to maintain the metallic currency at its present value; therefore a supply of between 8,000,000*l.* and 9,000,000*l.* is necessary for the arts and manufactures, and the purposes of coinage; and when we add to this our constantly increasing exportation of coin, it appears that the influx of Californian and Australian gold will produce but little change in its value in Europe."

EXPLOSIONS IN COAL MINES.

IN July, 1852, was printed the Report of the Select Committee of the House of Commons "appointed to inquire into the causes of the frequency of Explosions in Coal Mines, with a view to prevent the appalling loss of life arising from them." It would seem that the deaths from explosions have latterly increased to the fearful number of about 1,000 per annum; and the Committee proceeded to examine witnesses of the highest and most experienced character, in the hope that they might be able to derive sound information on which to recommend additional means for the prevention of such widespread calamities during the current session. It appears that the Davy-lamp requires increased ventilation in mines; and the Committee consider that the steam jet is the most powerful, and at the same time least expensive, method for the ventilation of mines. It was stated in evidence that 70 per cent. of the deaths from explosions were occasioned not by the explosion of fire-damp, but by the after-damp which succeeds it. Additional inspectors are recommended to be appointed, as some mines are never visited. The establishment of a central board is also recommended. It is suggested that to "the board should be given a power to enforce penalties under ordinary circumstances of neglect—and, in case of death. a power to facilitate an enforcement of justice to the families of the victims through the ordinary channels of law, the survivors themselves being in a condition of life which renders them comparatively helpless to obtain their just redress."

BELGIAN SAFETY-LAMP.

THIS new Lamp, the invention of M. Eloin, is manufactured by Thornton and Sons, of Birmingham. The cylinder above the flame is closed, and air is admitted only below the flame through a narrow breadth of gauze. A cap, on the principle of the solar lamp, causes the admitted air to be brought into actual contact with the flame, and thus producing perfect combustion, giving a light equal to at

least five or six ordinary Davy Lamps, and one which the collier would prefer to any candle. There is no wire-gauze to be injured, the light being radiated through a thick short cylinder of glass, which it has been found in practice is perfectly secure. It is bound top and bottom by a strong brass ring, and should it even crack, either by explosion or accident, the pieces would be still held together; and heating the gauze to redness is entirely prevented. The air which enters through the narrow breadth of gauze *below the flame* being only as much as is necessary to support the flame of the wick, and the combustion being perfect, that portion of the cylinder above must always be filled with the products of combustion, and never with an explosive atmosphere, which is clearly shown by the lamp being extinguished whenever the general upward current is reversed. So confident is M. Eloin of the action of the lamp in this respect, from his experience in the Belgian mines, that he has placed a very coarse wire gauze over the top of the lamp, simply for the purpose of preventing particles of dirt or coal dust from entering, but wide enough to admit flame, if any could be supported in the cylinder. A conical brass shade slides upon the rods surrounding the glass cylinder, which can thus, if necessary, be raised to the top, and form a reflector, to throw the light downwards, when required: this, we suggest, would be much more effective, if silvered or even tinned on the inner surface.—*Mining Journal.*

EVOLUTION OF GAS IN WALLSEND COLLIERY.

PROFESSOR PHILLIPS has described to the British Association this to be one of the numerous coal mines in Yorkshire which have been rendered remarkable for the frequent explosion of the inflammable and noxious gas with which they are filled, and the loss of life which has in so many cases been the consequence. In every coal-pit there are two shafts, one of which serves to admit the pure air, whilst the foul gases are made to escape by the other. The ascent of the foul gases is frequently facilitated by creating a draft by fires placed near the bottom of one of the shafts. The coal is arranged in perpendicular layers, between which the gases exist in a highly compressed state. In order to detach these layers with the least possible danger, it is usual to cut through them endwise, by which means the gases are allowed to make their escape at once from a considerable portion of the coal. A district of this colliery, covering about fifty acres, was effectually walled up, in consequence of the immense discharge of gas that was continually taking place. A pipe was led from this enclosed portion up through the mine and for forty feet above the surface, and from this pipe there has been a constant discharge of gas for the last eighteen years. This gas has been inflamed, and in the roughest and most stormy weather it has burned without intermission; and were it as rich in naphtha as ordinary carburetted hydrogen, it would illuminate the country for miles round. Two water-pressure gauges were fixed to the brick walls, one at the surface of the earth, and the other at the bottom of the mine; and the results were that, whilst the pressure in the mine was only 9-10ths

of an inch on an average, that at the top of the pit was upwards of four inches. From observation in these mines, it is seen that discharges of fire-damp, governed by atmospheric pressure, take place before being indicated by the barometer, and that as an indicator that instrument cannot be relied on. A fact somewhat similar was first observed by Professor Daniell, in his researches at the Royal Society, where the water barometer indicated the change of pressure an hour earlier than the usual mercurial standard barometers constantly used for observations.

SOLID COAL GAS.

"IT would be pronounced," says Liebig, "one of the greatest discoveries of the age, if any one could succeed in condensing Coal Gas into a white, dry, solid, odourless substance, portable, and capable of being placed upon a candlestick, or burned in a lamp." This greatest of discoveries has actually been made. A mineral oil flows out of coal in Derbyshire, which is obviously produced by a slow process of distillation from the coal; it consists, as fuel, of solid paraffine dissolved in a liquid oil. A consideration of the conditions under which this material product is formed has led Mr. James Young, of Manchester, to the discovery of a method (which he has patented) of readily obtaining the paraffine in any quantities required, and at a cheap rate (compared with ordinary candles), from ordinary coal gas.

HYDRO-CARBON CANNEL GAS.

THE Commissioners of Southport have published the details of four months' working with Boghead Cannel and Water Gas, by White's Hydro-carbon process, showing a clear profit of 24 per cent., after paying for all materials, labour, and interest on capital; the whole cost for labour and fuel being charged against the small quantity of gas required during the summer months. The gas at Southport is charged 6s. 8d. per 1000 feet. The consumption in the period embraced in the above return is under 3000 feet per day, although it is 30,000 in winter. The cannel was brought by railway from Scotland, at a charge of 16s. per ton for freight; whilst on this 3000 feet per day there is the same interest on capital and about the same charge for labour that would be on the 30,000. All the Scotch cannels, from their richness, suit admirably for this system, and are far superior to any English cannels; so much so that it is found advantageous to carry them by railway above 200 miles in preference to using the English cannels. A new source of traffic and profit is thus opened up for Scotland not previously imagined.*—*Liverpool Courier.*

BOGGETT'S PATENT GAS BATHS AND KITCHENS.

MR. BOGGETT'S new Gas Bath possesses in a pre-eminent degree the three most essential properties of such an apparatus—first, portability, the whole weight, when made in zinc, not exceeding what a

* *Mr. White's process is detailed in the Year-book of Facts, 1849, p. 171.*

couple of hands can readily move; second, convenience of use, the gas burner being attached to the bath, and lighted in an instant; and thirdly, accessibility in every part for purposes of cleansing and repair. The water is heated by a cluster of hollow vertical plates, placed at the foot of the bath, in close proximity to the burner, and it can be raised in less than twenty minutes to a temperature of 110° Fahr. The lighting is effected by drawing out a horizontal tube, perforated at top with a row of holes; then letting on the gas into this tube by a small tap; and next applying a light to the jets of gas emitted from the row of holes; after which the tube is turned round on its axis, and applied to the lighting of a series of larger burners.

The same inventor's Portable Gas Kitchen owes its superior cleanliness to this circumstance, that in all those cooking operations, where the article to be cooked is exposed to the direct action of the heat, as in roasting and broiling, the heat is applied downwards instead of upwards, as usual—whereby the possibility of any of the gas vapours coming in contact with the food, or of any unconsumed particles of carbon being deposited in the shape of soot, is completely avoided. Heating by ascent is confined to the processes of boiling, stewing, and baking, in which the articles, being placed in covered vessels, run but small risk of being affected. Where the gas used, however, is pure—as it may, and ought to be in all cases—it imparts no perceptible flavour in any case to the food cooked by it; much less so, indeed, than coal or wood. One of these kitchens, covering a superficial space of not more than a foot square, and with one burner only, consumes but 12 cubic feet of gas per hour, at a cost of less than three farthings; and it will at one and the same time perform all the roasting and boiling required for a large family.—*Mechanics' Magazine,* No. 1484.

GAS OVENS.

MESSRS. THOMPSON AND ATTREE have patented certain improvements in Heating Ovens by ordinary Coal Gas, which is conveyed by a pipe to the back of the interior of the oven and there ignited. A supply of atmospheric air is introduced by passing the gas pipe through another pipe (one end left open to the air), which passes through to the burner. The gas-pipe is connected with the main by a union joint, to admit of its being withdrawn from the ovens when the latter is sufficiently heated. When gas cannot be conveniently obtained, naphtha or other combustible fluid may be used in its place, suitable burners being employed and means used to introduce air to support combustion.

A NEW FUEL.

SOME curious experiments have been made at the Polytechnic Institution to test the results of a recent invention of Dr. Bachhoffner, for which patents have been obtained by the inventor and Mr. N. Defries. The invention consists in the substitution of thin pieces of metal in the place of coals in fire-grates,—which being acted on by *a small jet of gas,* immediately become red hot, and emit a prodigious

degree of heat. The flame which is produced by the proper but very simple management of the gas, co-operating with the metallic laminæ, gives the appearance of a brisk and cheerful coal fire, and can scarcely be distinguished from it. The heat can be regulated by turning the cock of the gas-tube. There is no deposit of soot, no smoke, nor any of the annoyances which attend coal fires; and the gas can, it is said, be extinguished *instanter*, or the fire kept as low as may be convenient. This invention reminds one of Edwards's Atmopyre, described in the *Year-Book of Facts*, 1852, p. 75; metal being substituted for clay.

NEW SMOKE-CONSUMING APPARATUS.

AN Apparatus, according to a Glasgow journal, has been originated by Mr. Aitken, of Murdoch and Aitken, Hill-street East, of that city. The flames from three furnaces meet in a central space or oven. The furnaces being fired in succession, at intervals of ten or twelve minutes, two of them are generally in a white flame, and on meeting the smoke from the third furnace (which is supposed to be newly kindled) in this oven between the boilers, it is immediately consumed before it can enter the flue of the larger boiler. The advantages of this apparatus, in addition to the great feature of the Consumption of Smoke, are described to be a considerable saving of fuel, a saving of the wear and tear of the principal boiler; and the facility with which it can be applied to boilers at present in operation, at a moderate expense, and in a very short time.

A NEW LAMP FOR USE AT SEA.

MR. THOMSON, surgeon, R.N., has submitted a plan to the Admiralty, by which candles and oil may be dispensed with, many thousands of pounds annually saved, and yet ten times more light secured to every ship afloat: this is accomplished by a simple method of using the slush from salt meats, now of no service. The candle-tube may be filled with water, yet it can be instantly expelled and the light fully maintained. The grease is so locked up that it cannot well escape, so that the Lamp may be rolled about the deck.—*Edinburgh Post.*

NEW ILLUMINATING APPARATUS FOR LIGHTHOUSES.

MR. GEORGE F. WILSON, of the Atlantic de Laine Mills, has explained to the Providence Franklin Society an Improved Apparatus invented by himself and Dr. Meacham, of Cincinnati. The improvements are a combination of the dioptric and catoptric methods of illumination.

"The lamp, which is of great illuminating power, has three concentric wicks, the diameter of the larger being two and three-fourths inches, with a separate oil chamber for each; and to which, by a simple arrangement of the conveying tubes, the oil is carried and constantly kept at its proper level, thereby dispensing with the rack-and-pinion for raising the wicks, as well as all the clock-work and pumps heretofore found indispensable in lamps of this kind.

"The reflectors, which are arranged both above and below the light, are

constructed upon a die, the form of which is obtained by the revolution of a parabola around an axis perpendicular to its own, and passing through its vortex; and the diameter of the lamp and the focal distance of the reflectors are so graduated to each other, that the most luminous portion of the light shall always be in this universal focus.

"To prevent the escape of any radiant light, a cylindro-plano-convex lens, having the same common focus, is placed between the middle and lower reflectors, which transmits and reflects it in a line parallel to a horizontal plane passing through the light. By this arrangement all the light evolved is thrown out in a horizontal belt, and is equally luminous or brilliant at all points. The whole apparatus, which pleases all who have seen it by its exceeding simplicity, will not cost more than 300 dollars; and while it would produce a light many times more efficient than the best catoptric apparatus now in use, it would save to our government more than 100,000 dollars annually."—*Scientific American.*

A NEW MATERIAL FOR ILLUMINATING LIGHT-HOUSES.

DR. GESNER, of New Brunswick, discovered some time since, in one of his geological surveys, a large Deposit of Bituminous Matter, not unlike asphaltum in its appearance and quality. This substance he has employed for the purpose of making gas-lights, which he finds very easily done. He has also successfully applied it to the purpose of making a brilliant light in Lighthouses upon the coast. The light-house at Meagher's Beach has been placed by Government under his charge. He has illuminated it at a charge of £19 per annum, making a saving of £50 per annum. The doctor proposes to furnish the other houses in the same manner, so that a saving of £15,000 a-year would be effected by this means. He also states that he can erect lights along the shore, without expensive houses, by raising poles and placing the lights upon them.—*American Paper.*

THE BEST VENTILATION.

Dr. ARNOTT, in his "Evidence before the Select Committee on the Ventilation and Lighting of the House of Commons," is of opinion that there cannot be a perfect system of warming and ventilating, in a building having separate rooms, if there is a deficiency in respect to any one of the following six particulars:—"Firstly. Means of moving through the building steadily the definite quantity of pure air known to be required. Secondly. Means of duly distributing this air to the different rooms and compartments. Thirdly. Means of properly diffusing the air in each room. Fourthly. Fit means of discharging the vitiated air from the room. Fifthly. Means of giving to the air the fit temperature. And lastly. Means of giving the fit moisture." Further, he thinks, that the more the apparatus is rendered self-regulating, or independent of the constant watching and interference of attendants, the better it is likely to be, both as to performance and economy.

TUB HOUSES.

Mr. GEORGE TATE has patented a mode of constructing Houses and other buildings by fitting together staves, or other timbers, secured together by hoops or binders, and fixed by any suitable method practised by builders, either vertically or horizontally, at any height, upon piles, sleepers, or frames, securely fastened in the ground; the joints

of the pieces or staves, when necessary, being bevilled as required, and wrought either plane or rounded, and hollowed or dovetailed, or tongued and grooved, or glued up or caulked, or merely drawn close together by the hoops. In the construction of buildings of greater height than the length of the staves or pieces employed, the horizontal jointings are to be made to break joint with each other. Such houses, he says, may be formed one within the other, so as to leave spaces between.

The floors, roofs, and partitions are to be formed on the same principle as the shell part of the building: that is, by tightly wedging up staves or pieces of timber, or other material of short lengths, according to the depth of the floor, roof, &c., in concentric rows, within an external hoop or other binder, and running the interstices solid with glue or other viscous and siccative matter, mixed or not with earthy or mineral matter.

The pieces may be dyed, or stained, or moulded, so as to form patterns, and to be trennailed or fastened together if necessary. The walls, whether internal or external, the inventor states, may be ornamented by the crystals of salts being deposited in the usual way on glass, and then fastened to the walls by applying glue or cement at the back. The hoops or fasteners should be so arranged as not to interfere with the openings required, such as doors and windows, and the staves, or pieces and hoops, may be painted or otherwise preserved from decay.—*Builder*, No. 470.

BENDING AND ANNEALING GLASS.

MR. F. HALE THOMSON, of Berners-street, and Mr. Foord, of Wardour-street, have patented a mode of combining means and apparatus for Bending sheets of Glass into concave forms, to be used for reflectors and other similar purposes, and for Annealing the same. The patentees take concave moulds—by preference, of cast iron, and as smooth as may be on the interior, and having a small aperture in the centre for the escape of air. These moulds are so constructed that they may be fitted in or on a vertical axis passing through the centre of the muffle or oven employed; which axis is so arranged as to be capable of being set in rotation, and of rising and falling for the purpose to be presently mentioned. The muffle (which is preferred,) is heated by two fires, one on each side exterior thereto; and the flames and heated products are caused to traverse the sides of the muffle through suitable flues, and to ascend and unite at about the top part of the muffle, so that the heat shall be greatest at the top. The moulding operation is performed as follows:—A mould is introduced into the interior of the muffle and supported on the axis; and when it has reached a dull-red heat, it is withdrawn from the muffle, and a plate of glass having been placed thereon, it is again introduced, and allowed to remain in the muffle, being gradually raised by lifting of the axis, so as to subject the glass to different and gradually increasing degrees of heat, until it attains the bending point, which will be readily ascertained by the workman looking through an eye-hole. As soon as this is the case, the workman

takes a convex piece of soft wood or cork, dipped in water; and having set the axis in rotation, he applies the same to the sheet of glass on the mould, and continues to keep it in contact therewith, using for this purpose slight pressure until the glass is brought to the concave shape of the mould. He then takes out the mould and concave sheet of glass from the muffle, and having covered the same with a piece of sheet metal, sets them aside to cool. The cooling in this manner will be found to partially anneal the glass; and the process of annealing is subsequently completed by heating several such concave pieces or forms of glass in a muffle, and allowing the same to cool, as is well understood.

ROUGH PLATE GLASS.—IMPORTANT DECISION.

In the Court of Exchequer, on the 13th of April, a case was decided in regard to the patent of Mr. Hartley, of Sunderland, which appears to settle the question of originality of invention in favour of Mr. Hartley; although the sole secret seems to have consisted in ladling rough glass directly on to a hot table near the melting pot, in place of carrying it as usual out of the refining pot to a cold table at some distance from the furnace. One firm it was stated; expended £25,000 in the vain endeavour to use the ladle and to draw the table close to the rough melting pot! The most important discoveries are often so simple, that every one afterwards is only astonished how they could be so long in being made. The consequence of this simple invention or discovery is, that rough plate glass, not transparent, but perfectly well adapted for extensive use in railway stations, in horticulture, and in workshops and otherwise, can now be made in minutes instead of hours or days; and in patterns stamped by the table, which becomes so hot as to be capable of keeping the glass molten till stamped, and till one ladleful is added to another and perfectly united with it in imperceptible junction or welding, so that plates of any size of glass can now be made at comparatively small cost. The defendant in the case under notice was Mr. Hadland, of the Eccleston Glass Works in Lancashire, who seems to have been experimenting, as did many others, in search of cheap processes at the time when the duty was taken off glass; and who contrived to do so, and at length, *after* employing a nephew of Mr. Hartley in his works, succeeded in making and selling an article identical with that of Mr. Hartley's patent, but only after the date of that patent. He claimed the use of the ladle, however, previous to the date of the patent; but a verdict was given in favour of the plaintiff, after a long trial, reported in the *Sunderland Herald.—Builder*, No. 476.

COKE BRICKS.

An invention has been patented by Mr. William Pidding, of Chiselhurst, Kent, for the adaptation of a preparation of coke, by which bricks, paving slabs, door and stair-steps, columns, cornices, capitals, tiles, pipes, blocks, railway sleepers, and other articles in request by builders for all the ordinary purposes of their trade, for *which clay, brick, stone,* or marble is now used, can be produced.

In the specification, it is stated that an article similar in shape, size, and colour to the various kinds of bricks now in use, of tenfold durability as compared with the best manufacture supplied from the kilns, and but of one-third the weight, can be produced at a cost varying from one-third to one-sixth of the price of the present article. It is said to be impervious to damp, or any other atmospheric influence, and that by a peculiar process it is rendered indestructible by the agency of fire.—*Builder*, No. 497.

SLATE MANUFACTURES.

In a paper read to the Liverpool Polytechnic Society, Mr. Rayner states—that Slate has become an article much more sought after than formerly; that an inch slab of slate is equal to York paving 2 or 3 inches, granite 3 to 4 inches, and marble even 8 to 10 inches thick: that it is an almost perfectly non-absorbent body; for if an inch slab be immersed in water for three months, it will be found, on merely scratching the outer surface, to be perfectly dry underneath; that hence it is not liable, like stone, to be injured by frost; that hence, also, it is extremely useful for chemical purposes, mangers, &c.; and that in this age of competition it has been made to undergo a process of enamelling which totally changes its appearance and value. During this process it passes through five distinct operations: first, there is the ground coating, burnt in, and afterwards rubbed down to a fine surface to prepare it for the pencil of the artist, who gives it either the appearance of the richest sienna, brocatella, granite, porphyry, or even inlaid work; after which it receives the first coating of enamel, and is again subjected to heat, and again rubbed down. It receives in all three coats of enamel over the painting, all of which having been thoroughly burnt into the slate, at a heat ranging from 350 to 600 degrees, not only protect the work, but secure for it a surface which will carry a higher polish than any similar article.

FELT CLOTH CARPETS.

The *Journal of Commerce* describes a novel manufacture which the Bay State Mills have produced—a Felt Cloth Carpet, printed in block work, and designed according to weight either as a floor cloth or drugget. The threads of wool are not spun or woven, but drawn out and laid together, the whole mass being felted like a hat body. Within a few months, fabrics have been put together in this way, showing a different colour on either side, and designed for coats to be made up without lining. The Bay State Mills make this cloth with a white ground, about 40 inches wide, weighing from four to twenty-four ounces per yard; they print it in elegant carpet designs, showing the richest combination of brilliant colours, and furnish it at 75 to 90 cents. per yard.—*Scientific American.*

WOOD SCREWS.

Mr. Newton, of Chancery-lane, has patented an improvement in the manufacture of Screws for fastening Wood, &c. Instead of shav-

ing the heads, either before or after the nick, they are first cut to a more obtuse angle, then the nick given, and afterwards shaved, by which means all burr and irregularities are removed. The jaws of the nicking machine are furnished with a spring, by which they are made to hold various sized screws; and in pointed screws the blank is cut to the proper form before cutting the thread. An improvement in the feeding and supplying of screw blanks, pins, and other similar articles, is effected by apparatus furnished with hooked fingers, by which the articles are seized, the heads preventing them from slipping; also for assorting them according to length or diameter: and a machine is described for shaving the heads, forming the nick, and re-shaving, without removing from the jaws in which they are first held.

EWING'S PATENT GLASS WALLS.

WHEN the late Sir Robert Peel proposed his measure for the removal of the duty from glass, he wisely remarked, there was no foreseeing the limits of the novel application of this beautiful manufacture. The most recent of these is the use of Glass in the Construction of Walls for the growing of fruits and plants, as well as the introduction of a new style of architecture. The variableness of the British climate, and the great disappointment in procuring, with anything like certainty, a crop of fruit from brick or stone walls, led Mr. Ewing to consider whether this could not be obviated by substituting hollow walls of glass and iron; and the invention has proved perfectly successful. By constructing the walls of sufficient width to enter, they become hothouses on the best principle; the trees they contain are completely surrounded by light and exposed to the action of the sun's rays during the whole of the day; they form a delightful promenade in our uncertain climate during the winter months. One of these walls has been erected by the London Horticultural Society, in their Gardens, at Chiswick. Mr. Ewing has invented a simple method of opening the lights by machinery, by which means a lady can easily open the whole of the sashes on either side of the wall at pleasure.—*Illustrated London News*, No. 574.

SHIFTING BRICK HOUSES.

A BLOCK, three stories high, has been safely removed 10 feet 6 inches backwards, at the instance of the commissioners for widening the streets of an American town. As possibly the plan might be of use in some of the towns of Old England, where the old and narrow thoroughfares are choked by the traffic of our free-trade age, we subjoin the *modus operandi*. Concave cast-iron plates are prepared, the foundation of the wall cut away, and two plates facing each other inserted, with cannon balls between them. On these plates and balls, placed under all the walls, the whole building rests. Three screws are applied, and the whole building is rolled upon them any distance. These plates and balls are removed one by one, and the bricks replaced. It is estimated that the block weighed *7,000 tons*. *It* was rolled on one hundred and twenty balls, and was

d, after the plates were set, in about two hours' time.—*Boston*

IMPROVED LUCIFER MATCHES.

IRS. J. and E. STURGE, of Birmingham, manufacture on a large new description of Phosphorus for Lucifer Matches (called ious phosphorus), which possesses the following advantages e old. 1. It involves much less risk of destruction of life operty by fire; 2. It is more suitable for matches intended for climates; 3. It is not poisonous in the solid form, so that s made with it will be comparatively harmless if sucked or .; and, 4. It does not give off any noxious vapour at ordi- mperature.

simplest lucifer-match consists of a splinter of wood dipped elted phosphorus, and then covered with gum or glue. More itly phosphorus is associated with chlorate or nitrate of potass, th sulphur or sulphuret of antimony. The employment of aterials necessarily renders the manufacture a very hazardous om the risk of fire; and in certain of the Continental states the ation of lucifer-matches has been absolutely prohibited. er and quite unexpected hazard was soon found to attend their icture. The workpeople were attacked by a very painful and atal disease of the jawbones, which became carious, occasioning iy cases death, in several loss of the upper or under jaw, or severe mutilation, and disfigurement, and always much suf- The German surgeons, who have paid great attention to this sing disease, refer it to the absorption of the vapour of phos- , given off chiefly during the drying of the matches, but like- t other stages of the manufacture. Phosphorus, also, is well to act as a poison when swallowed in the solid form, and as it in this condition in lucifer-matches, fatal accidents have more nce occurred from children sucking them.

red or amorphous phosphorus is much less combustible than ry phosphorus, and not at all poisonous. To prepare the new ice, ordinary phosphorus is melted in a peculiarly constructed and kept for some hours at a temperature of about 500° Fahr. singular change is the result of this heating, during which osphorus combines with caloric, and renders it latent, but does ierwise undergo any chemical alteration. The original phos- is a pale yellow or white transparent body, so combustible ; must be kept under cold water: when brought into the air ws luminous even at the freezing point, and enters into full at a temperature of about 150° Fahr. By prolonged heating, omes a soft opaque mass, which is easily pulverised, and then an uncrystalline powder of a scarlet, crimson, purple-brown, wn-black colour, so incombustible that it may be exposed in ir in the open air, and handled with impunity; nor does it uminous till it is about to enter into full combustion at the ature of 482° Fahr. It is further so harmless to living crea- that more than a hundred grains have been given to dogs

without doing them any injury. Although, in its free state, it is sparingly combustible, yet, when it is mixed with the ordinary ingredients of lucifer-matches, such as sulphur or sulphuret of antimony and chlorate of potass, it kindles readily.—*Mechanics' Magazine*, No. 1505.

STEARIC CANDLE MANUFACTURE.

In a lecture delivered at the Society of Arts, by Mr. G. F. Wilson, the able managing director of Price's Candle Company, at Vauxhall, the process at present employed on the works is thus briefly described:—

"Six tons of our present raw material, palm oil, are exposed to the combined action of 6¾ cwts. of concentrated sulphuric acid, and a temperature of 350° Fahr.; in this process the glycerine is decomposed, large volumes of sulphurous acid gas given off, and the fat changed into a mixture of fat acids of a very dark colour, with a high melting point: this is washed to free it from charred matter, and adhering sulphuric acid, and is then transferred into a still, from which the air is excluded by means of steam. The steam used by us is heated in a system of pipes, similar to those used for the hot blast apparatus in the manufacture of iron, the object of heating the steam being to save the stills, and reduce as much as possible gaseous loss in distillation.

"It was long supposed that arsenic was requisite in making perfect stearic candles. Wax was afterwards known as a substitute, but its expense was a great drawback to its use. At this time, the candle material was poured at a high temperature, about 240°, into cold moulds, and being long in congealing, crystallization would have taken place, and disfigured the surface of the candles. Arsenic and wax disturbed the formation of the crystals, and produced a uniform surface. Soon after the use of arsenic was proved to be dangerous, it was discovered that if the stearic acid was poured at its congealing point into moulds, at about the same temperature, perfect crystals could not form, and that beautiful candles were produced. The object for the use of arsenic was thus done away with.

"There is no doubt of the employment of arsenic being unsafe; but a great deal of nonsense was talked about it, and the public took refuge in spermaceti candles, many of which, I am credibly informed, at that time contained more arsenic, to break their larger crystals. It is not now, I believe, ever used either in spermaceti or stearic candles."

Mr. Wilson then describes the processes of preparing the wicks and of moulding:

"The cotton after plaiting is dipped in a solution of a salt, frequently borax; it is often supposed that this preparing has for its object to render the wicks more combusible, but the reverse is the fact. The plaiting gives the required curve to the wick, the solution preserves it from being much acted upon by the flame, except at its extreme point, at the edge of the flame, in contact with the air, where it is consumed. The means principally employed by us for moulding, are these:—The frame has a box attached to it, containing a bobbin for each mould; and the self-same movement that expels the one set of candles from the mould uncoils a sufficient length of wick for the next; this is separated from the finished candles by means of a knife travelling on a rack; a set of forceps then holds each wick over the centre of its mould, which is now passed along a railway through a closet heated by steam-pipes, by which it is raised to the required temperature by the time it arrives at the filler; having received its charge, it passes on till the material is sufficiently cooled to allow of the forceps being withdrawn without disturbing the position of the wicks—a little further on the superfluous material is scraped off—the mould is then passed across by means of a travelling truck to a parallel line of railway; by the time it has traversed the length of this, and arrived at the drawer, the candles are sufficiently cold to be removed. Each machine has on an average 200 moulds, each mould contains

18 bobbins; and each bobbin, when first cottoned, 60 yards of wick; so that supposing all the frames of our seven machines to be fresh cottoned at the same time, we should have above 800 miles of wick in work."

Six kinds of candles are made at the Belmont works. 1. Belmont sperm: of hot-pressed palm acid. 2. Belmont wax: the same material, but coloured with gamboge (to suit the refined prejudices of the home consumers). 3. Best composite: of the same material as 1 and 2, but mixed with cocoa-nut stearine. 4, 5, and 6. Composite 1, 2, 3, of inferior quality. The machinery for making the candles was shown and explained; and as an example of the very large scale of the operations of the Company, it was stated that 800 miles of wick are continually being converted into candles. The opinion of the lecturer is, that the candle manufacture was very well represented at the Great Exhibition; but that the difficulty of judging between the different products was rendered almost impossible by the consideration of the cost of manufacture being excluded. When the process is so simple and so invariable, the whole question turns on the cost of manufacture; and the jury, by awarding such a large number of prize medals for stearic candles, confessed that they felt this difficulty. The Council Medal was awarded to M. De Milly; thus giving precedence to an old process over a new one, which has grown up in successful competition with its ancient rival. The latter part of the paper consisted of a relation of details of the highest interest, to show the moral value of the trade in palm oil, as a means of gradually introducing civilization to Africa, and of thus putting an end to the slave trade. From the evidence of several persons well qualified, as merchants and residents in Africa, to judge, it is established beyond a doubt that hitherto the result of the trade has been to introduce a taste for the articles and institutions of civilization which was before utterly unknown in the districts which are the seat of it; that any amount of palm oil (not to speak of other vegetable and animal products) can be obtained, involving a proportionate exchange of the goods, and a consequent introduction of the ideas of civilized countries.

The Stearic Candle Manufacture has of late years become an extensive one; in the Belmont works alone are employed above 900 hands; and in one winter have been made 100 tons—£7,000 worth—of candles weekly.

AMERICAN BACK-STITCH SEWING MACHINE.

MR. WALCOTT, of Boston, has exhibited to the Franklin Institute, Robinson's Back-Stitch Sewing Machine, in operation. Its object is to produce either what is generally termed stitch and back-stitch sewing or ordinary sewing; but this machine not only sews the regular back-stitch, but, with slight mechanical adjustment, the basting, whipping, quilting, and cordwainers. There is a combination of two needles, two thread guides, and a cloth-holder, made to operate together; each needle having a spring to which pressure is applied in passing through, which spring retains the thread. The whole *is worked by a wheel* which governs and regulates the motion,

with a handle which could be turned by a child; the entire apparatus showing great mechanical skill and ingenuity.

The advantages claimed for this machine over all others, are the durability and the fastness of the stitch, the perfect simplicity and compactness of machinery, and the many purposes to which it can be applied. The stitch taken by this machine is a *fac-simile* of hand-sewing: consequently, it can be successfully applied to the same purposes. It also possesses many advantages even over hand-sewing, which the practical tailor admits. The sewing produced is more accurate, makes a firmer seam, and is more durable than that done by hand. In hand-sewing, at intervals of stitches, the thread remains loose, and therefore allows the stitch taken to slack, which is here overcome by keeping the thread continually tight by means of thread-holders, acting in the capacity of fingers.

In seaming clothing with silk, it is very necessary that the silk should be waxed to give a firm seam. It is well known that all kinds of silk will stretch about one inch in ten. This machine will work the silk waxed, as well as without.—*Proceedings of the Franklin Institute.*

BOTTLED FRUITS.

It appears from the Report of the Analytical Sanitary Commission, published in the *Lancet*, that the public cannot be too cautious in the purchase of their Bottled Fruits, preserves, &c.; inasmuch as manufacturers, in order to please one taste only, that of sight, are in the habit of using a preparation of copper so as to improve (?) the colour of the articles they sell, and thus sacrifice flavour, quality, and even safety. Thus, bottled fruits, &c., purchased at the houses of some of the first West-end tradesmen, have been found to contain a considerable quantity of copper, which could be readily detected by placing a smooth, well-polished rod of iron in a vessel containing about three ounces of the fluid in which the fruit or vegetable is preserved; the acidity in which should be previously increased by the addition of about three drops of strong nitric acid. On removing the iron rod from the test tube, it will be found covered from top to bottom with a continuous and bright coating of copper; if the amount of copper in the suspected article were less, the rod would be found only partially covered. Other and finer tests are used where the quantity is inconsiderable. The Report then publishes the names of the vendors of the adulterated articles, and the name of only one firm whose fruits and vegetables were ascertained to be free from copper, with the exception of greengages, which contained a trace only of the poison. The Report concludes by an expression of regret that the Commissioners were unable to have their paper ready before, as it might probably have deterred persons from using so freely such a poisonous ingredient as copper in the preservation of fruits, &c.

THE CURVILINEAR OMNIBUS.

In this new Omnibus, invented by Mr. Tucker, New Kent-road, *the seats are divided*; the interior is ventilated both above and

beneath, and the glasses are therefore fixed so as to prevent either rattling noise, or disputes about opening and shutting them. The back of each seat is curved outwards, so that a greater width of passage is obtained. The feet sink into boxes, to prevent treading on them. Between and above each seat is a bell-pull acting on a single bell near the conductor's place. Access to the top is facilitated by steps.

NEW UNIVERSAL COIN.

"WE have now before us," says the *Cork Southern Reporter*, "a specimen of a New Universal Coin, designed to facilitate the system of exchanges among the different civilized nations of the world,—and which, if adopted, would certainly tend materially to put an end to the confusion about the currency of various places of which every traveller has had such annoying experience. The designer of it is a gentleman well known in the scientific world for his politico-economic essays on many important subjects, Prof. Neilson Hancock. Without diagrams it is not easy to give an exact idea of it, but the description may be thus stated.—The coin is of silver, containing 37 parts of that metal to 3 parts of copper. Its weight is one ounce troy, and its value, in the coin of Great Britain and Ireland, is *5s.* *2d.* The weight is expressed in English, German, and French, on one side, and on the reverse the proportions of the two metals in the same languages. Its value, in the existing currencies of twelve countries, is likewise stamped on it thus:—England, *5s.* *2d.*; America, 1 dollar 19 three-fifth cents; France, 6 francs 39 centimes; Naples, 1 ducat 50 grani; Austria, 2 florins 27 three-fifth kreutzer; Prussia, 1 thaler 21 two-thirds silber grosschen. On the reverse—Spain, 1 dollar 5 reals 28 maravedis; Portugal, 1 milrei 71½ reis; Russia, 1 rouble 60 copecs; Holland, 2 gulden 99 cents; Hindostan, 2 rupees 10 annas 10 pice; China, 7 mace 8 candareens 4 four-fifth cash. There is no device of any sort, if we except a very minute representation of the terrestrial globe, which hardly deserves the name; and it is a plain, unpretending, but thoroughly useful piece of money, well calculated to serve the purposes for which it has been designed. On the continent of Europe, especially, it would be very desirable to have such a coinage in lieu of the miserably depreciated currency now so general there."

SUGAR MANUFACTURE AND REFINING.

MR. BESSEMER has explained to a number of gentlemen connected with the West Indies, merchants, sugar-bakers, and refiners, various parts of his new Mode of Manufacturing Sugar, as in operation at Baxter House, Old St. Pancras Road. The brown sugar of commerce did not, he said, contain that immense quantity of impurity which it was generally supposed, from the large amount of residue left in the process of refining. Of forty-two samples of Muscovado analysed by Professor M'Cullagh, an average yield of saccharine matter was *obtained equal* to 93 per cent. The large amount of

residue obtained in the present refining process was owing to the high temperature in which the water was evaporated in the ordinary boiling process, and to the heated surfaces of the coil coming in contact with the sugar in the vacuum pans. By the new process, this excessive waste of impurity would be avoided. In the cleansing process he proposed simply to use water, acting upon a surface of sugar spread upon a wire gauze over a vacuum. Some samples of the sugar cleansed by the process were shown by Mr. Bessemer, from Demerara, Jamaica, Barbadoes, and Grenada. The difference in the value of the sugar as imported and as cleansed was £12 per ton; while the actual cost of the mechanical process of cleansing did not exceed 5*s.* per ton. So small a quantity of the saccharine matter was carried away by the water, that it might be used several times in the cleansing process, until it began to assume a density for operating upon; when it was placed in the evaporating pan, and a considerable quantity of crystallized sugar would be obtained, the molasses remaining being almost white. Mr. Bessemer next explained his filtering process, and passed on to his mode of evaporating by hot air. The last process would throw off 300 gallons of water per hour, as compared with 180 gallons by the vacuum pan, the heating media would not exceed 145 deg., and the temperature of the liquid 110 deg., while in the vacuum pan the heating media would be 235 deg., and the temperature of the liquid 175 deg. By the new process, none of the saccharine matter would be thrown off mechanically or lost in vapour, as was the case in the vacuum pan, owing to the great force of the steam, and the ebullition of the liquid. Mr. Bessemer also explained the mode by which the sugar cleansed by his process was converted into perfect loaves in the space of twenty minutes, instead of, as now, a space of three weeks being consumed in the operation. The sugar was scraped from the cleansing-machine into moulds placed on a revolving frame, and then subjected to pressure from the blows of a piston, as they were carried round on the circular frame; and, having completed their circuit, were raised by a pressure from beneath on to an endless web, which conveyed them to the drying shelves. 2,400 lbs. of loose sugar could thus be converted into loaf every hour, with the attendance of one person, and a steam-engine of 4-horse power.

RAMO'S PATENT SUGAR REFINING PROCESS.

By this new process ten gallons of plantain juice (the tree cut into pieces, same size as a cane,) are passed through the mill, same as the sugar cane; mix the 10 gallons with seven pounds of Bristol lime, let it remain one hour, or more, until well mixed, then pour it off; to this liquid, add one ounce of flour of sulphur; put about one wine bottle of this liquid to each stroke, and then add, or lessen the quantity as may be required,—if more lime be required, it can be put. This liquid will bring up all the filth of the cane juice. The *first scum* of the copper must be struck off into the gutter, and *sent into the vat* for Rum, and not as now struck from copper to

copper. This will enhance the value of Sugar 20 per cent. or more.—*Jamaica Paper.*

MACHINERY FOR SUGAR MANUFACTURE.

MR E. DE MORNAY, of Mark-lane, has patented certain improvements in Machinery for Crushing Sugar-canes; consisting of new arrangements of single and double-acting roller mills. In the "single acting" mill, the feed-roller of the ordinary three-roller mill is replaced by one of a smaller diameter than the crushing rollers, or two or more such small feed-rollers are employed, by which means the trash-returner is enabled to be altogether dispensed with; and the crushed cane is delivered from between the rollers in such manner that there is less liability than usual of its absorbing any of the expressed juice. In the double acting mill, two sets of crushing rollers are employed, having a trash-returner to direct the cane between the second pair of rollers after it has passed through the first pair. A feed-roller of small diameter, or two or more such small feed-rollers, are also employed with this arrangement of roller mill.

Under this branch of his invention, the patentee also specifies some improvements on the cane press, patented by Mr. H. Bessemer, in April, 1849: viz., in making the sides of the perforated tube, in which the canes are compressed, to diverge gradually from the feed-end to about the middle of its length; from which point to the discharge end, the sides may be either parallel to each other or converge, as may be found in practice most desirable.

The improvement in apparatus for evaporating consists in forming evaporating pans with transverse partitions, capable of sliding in the pans from end to end; so that while the evaporated juice is being discharged at one end of the pan, a fresh supply may be introduced at the opposite end of the pan. Instead of one such partition, two or more may be applied. A second improvement consists in the introduction into the evaporating pans of wires laid transversely across the pan, near the bottom, for the purpose of dividing the juice in its flow, and bringing it into contact with atmospheric air, to enable the process of evaporating to be conducted at a low temperature.

MANUFACTURE OF BEET SUGAR IN IRELAND.

A REPORT on the "Inquiry into the Composition and Cultivation of the Sugar Beet in Ireland, and its application to the manufacture of Sugar," has been laid before Parliament; from which it is satisfactory to learn that the sanguine expectations entertained of this new feature in the agriculture and manufactures of Ireland are fully confirmed. Little doubt existed that the soil and climate of that country were eminently adapted to its growth; while the cost of production, as stated by various practical authorities, after making a liberal allowance for manure, has been found not to exceed a range of from 5*s*. 6*d*. to 8*s*. 6*d*. per ton. The influence of soil and manures is found to have variously affected the sugar-yielding properties of the roots. From a long series of experiments upon a manufacturing scale, made by *Professor Sullivan*, at the Museum of Irish Industry,

from 10 to 14 per cent. was frequently obtained; while out of 118 determinations the roots from two or three localities only yielded under 7 per cent. The average result of the whole 118 specimens was, however, over 9½ per cent.

ADMIXTURE OF CHICORY WITH COFFEE.

NO problem in science (certifies Dr. Ure, F.R.S.), is simpler or more certain than the detection of Chicory, or of similar substances, in Coffee powder. Ground roasted coffee imparts to cold water merely a pale sherry colour; whereas when it is adulterated with ground roasted chicory, it communicates a brown colour, of greater or less intensity, to cold water. If three glass tubes, set upright, be charged respectively with a few grains' weight of 1, pure coffee; 2, of pure coffee mixed with a little chicory; 3, of Coffee mixed with much chicory, and if into each of these tubes a like quantity of cold water be poured; if after agitation the tubes be set upright at rest, the solid particles will soon fall to the bottom, and the transparent liquid in the stems of the tubes will show, by the variable depths of the tinctures, the presence and proportion of coffee and chicory in each of them. An apparatus for making this experiment may be had for one shilling, at Brown's, 46, Farringdon-street, London.

BREAD-MAKING MACHINERY.

M. LECOMPTE DE FONTAINEMOREAU, of South-street, Finsbury, has patented certain improvements in Apparatus for Kneading and Baking Bread, &c. The "apparatus for kneading" dough consists of a semi-cylindrical trough, within which is placed longitudinally an axis or shaft, to which are attached on the opposite sides two rows of radial arms, the arms on one side of the shaft being placed opposite the spaces between those on the other side. The ends of the arms of each set are connected together by rods parallel to the shaft which carry short arms projecting inwards, and placed between the long arms. The shaft is driven by a winch handle; and the action of the arms, when it is in motion, effectually kneads the dough contained in the trough without any of the disadvantages attendant on hard labour. The "apparatus for baking" consists of a circular oven, provided internally with a revolving table, on which are placed the articles to be baked; and which table is made to rise or fall, as may be required, to change the temperature. The bottom of the oven is heated by tubular flues, under the moveable table; the sides by vertical flues, which lead from the fire-place to the top of the oven, where space is left for the heat to circulate over the whole of it. Above the top flue, which is formed by two plates of metal, the oven is covered with earth, except at one part, where is fixed a receptacle to contain water for the service of the kneading apparatus; such water being heated by the flames, &c., passing through the flue on the top of the oven. A thermometer is applied to the exterior to show the degree of heat, and dampers are provided *for its regulation.*

BREAD AND BISCUIT MAKING MACHINERY.

MR. EXALL, of Reading, engineer, has patented the following improvements:—1. The patentee proposes to make Bread and Biscuits from a combination of about equal parts of wheat-flour, barley-flour, or meal, bean-flour, or meal and potatoes mixed thoroughly together, and slightly fermented; then baked in the form of small loaves or biscuits, which will be found to keep longer than ordinary bread, and to be more palatable than the common ship biscuits.

2. For kneading flour into dough, Mr. Exall uses a hollow screw, or spiral bar of iron, revolving in a cylinder or tube. The materials to be kneaded are supplied by a hopper at one end of the cylinder, which occupies a horizontal position, and forced out at the opposite end through a mouth-piece of any suitable form of orifice. This machine is specially claimed for making bread with the new combination of flours before described, and also for kneading clay and other plastic materials.

3. The kneaded dough, previously passed through a pair of roughing rolls, is placed on a feed-table, and supplied in a sheet of any desired thickness by a pair of rollers to a travelling web, which carries it successively under the operation of marking or stamping dies, and then under the cutters, each of which apparatuses has a reciprocating vertical motion, by which the dough is stamped and cut into the form of biscuits. The latter are then removed from the travelling web, and transferred to the oven. Where the biscuits are round and cut to waste from the sheet of dough, the apparatus is so arranged as to separate the detached fragments, and prevent them going to the oven with the rest.

4. A new form of oven is described, in which the baking is effected in the interior of a series of horizontal tubes, set like gas retorts above a fire or in a flue, and open either at one or both ends, but provided with suitable doors for keeping the same closed during the operation of baking.

THE BOSTON FIRE ALARMS.

DR. W. F. CHANNING is stated, in *The Boston Almanack for* 1852, to have first published the application of the Telegraph to Fire Alarms in 1845. This gentleman laid the details before the Boston City Government in March, 1852, and 10,000*l*. were voted to carry the system into operation in June. The length of wires erected in the city is 49 miles. There are duplicate wires between every station. They are seldom broken, however. The circuits are tested hourly. The signal station is a small cast-iron box placed on the side of a building. Responsible persons in the immediate vicinity have the keys; and at an alarm of fire, the crank in the box is turned slowly round six times, and intelligence is thus conveyed to the City building of the exact locality of the fire. In each church, connected with the alarm circuit, is machinery like the striking part of a clock, with a weight attached, and an electro-magnet, connected with the circuit. When the operator at the City building receives intelligence from any signal station, he strikes, by means of the alarm circuit, on all of the

bells at the same time, the number of strokes corresponding with the district from which the signal comes, and the firemen immediately know where they are wanted. The circuits of wire are so arranged that no alarm can be communicated except from the signal boxes, forty in number, placed throughout the city about 100 rods apart. An officer of the fire department can ascertain the number of the station in any district from which an alarm of fire proceeds, by going to any signal box and making the simplest signal. The operator at the central office will reply by counting out the number of the station, by means of the clicks of a little electro-magnet in the signal box in which the inquiry is made. The position of the fire would then be known within 50 rods. If a fire is soon extinguished, the engineer sends to one of the signal boxes, and communicates the signal of "All out," which is "*one, one-two,*"—"*one, one-two,*" to the central office; from whence the same signal is struck upon the alarm bells, and the engines in all parts of the city are enabled at once to turn back.

The instruments in the central office are thus described:—a triple Morse register, a triple receiving magnet, a triple alarm bell apparatus: these, with the necessary keys and switches, are connected with the signal circuits. An instrument called the "district keyboard;" a triple alarm register and proper switches are connected with the alarm circuits. An instrument called a "testing clock" is connected with both signal and alarm circuits, and once each hour gives notice on a small bell of the integrity or interruption of the various circuits: the battery room is No. 13 of the same building. The interior of the central office, says the *Boston Transcript*, "well deserves to be considered the brain, or at least the *cerebellum* of the city. It is the centre of two sets of iron nerves, the signal or sensational system, by which it receives intelligence from every one of forty distant stations scattered all over the city; and the alarm or motive system, by which it disperses that intelligence simultaneously to all quarters of the city, and arouses its muscular energy by means of nineteen heavy bells. Thus, by a slight pressure with one of his fingers, the central operator sets in instant motion engines of alarm equivalent to nineteen stout men, and ensures absolute precision and agreement in their signals. They are made to tell the story of the locality of the fire intelligibly and unmistakably. The sensation at one point is propagated through the central office, or brain, to all parts, almost as quick as thought. The mechanical adjustments in this office are very ingenious and beautiful, and reflect great credit on Mr. Farmer, (superintendent of construction) and Dr. Channing (the originator.)."

THE COTTON MANUFACTURE.

MR. BAZLEY has read to the Society of Arts, H. R. H. Prince Albert in the chair, a paper entitled "Cotton as an Element of Industry: its confined supply; and its extending consumption by increasing and improving agencies." The lecture was divided into two parts, the first of which treated of the progress of the

manufacture; the second, of the sources whence the raw material is supplied. In the latter, Mr. Bazley called attention to the increase in the consumption of cotton wool in this country. At the commencement of the last century it was little more than 1,000,000 pounds weight per annum, while the work-people employed on it did not exceed 25,000; but at the close of the century 52,000,000 pounds weight per annum were consumed, and the numbers employed were 125,000. Few articles are more generally applied in manufacture than cotton. Its finest qualities are worked into lace and muslin, while from its very waste excellent letter-press paper is made. A very extensive trade has sprung up in Bradford, and other places, in "mixed goods," and "union cloths," which are composed of cotton in combination with worsted, silk, or thread. The cotton manufacture has had many variations, and under the restrictive policy it suffered great depressions; but since the alteration in the fiscal system of the country, a beneficial change has taken place, and the race is now free to all. During the past year no less than 760,000,000 pounds weight of cotton were consumed in this country, passing through the hands of no fewer than 1,250,000 actual workers, or including their families, three millions and a half of our fellow subjects, an eighth of the population of the United Kingdom; while the exports in 1851 amounted to 30,000,000*l.* sterling. Some idea may be gained of the beneficial nature of this industry to the national treasury, from the fact that 12,000,000*l.* sterling, or one-fourth of the whole revenue, is contributed in taxes by those engaged in it; whilst the area occupied by their operatives is not more than one-hundredth part of the surface of the country.

In treating the second part of his subject Mr. Bazley drew attention to the singular fact that although the British colonies contain a greater extent of land suited to the growth of cotton than is to be found under any other dominion, yet that the supply derived from them is less in quantity and far inferior in quality; the supplies in 1851 were, from foreign countries, 1,569,800 bags; from the colonies, 333,700 bags. And while 16,000,000*l.* were paid for the foreign cotton, only 2,000,000*l.* were realized by the colonial. Of this large amount from foreign countries the great proportion comes from America: and individuals are now living who recollect the arrival of the first supplies in 1787; the value of the whole crop being now 30,000,000*l.*, equal to that of the wheat crop of this country. Surely this is a lesson to other countries possessing equally favourable conditions. The lecturer then glanced at the capabilities of the different British colonies, for producing this material. The West Indian Islands, Port Natal, and our other African possessions* were stated to

* Mr. Thomas Clegg, of Manchester, received, during the past season, from the western coast of Africa, upwards of 10,000 lbs. of Cotton. The circumstances under which these arrivals have occurred, are as follow. Some three or four years ago, Mr. Clegg, learning that there was plenty of cotton growing wild near the colony of Sierra Leone and the Church Missionary station of Abeokuta, and that as it bloomed and ripened it dropped to the ground and rotted, he communicated with the officials of the Church Missionary Society in London, and through them sent 100*l.* to the place named, with instructions that it was to be

be capable of growing cotton quite as well as the United States; while Australia would produce an unlimited amount equal to the very finest. And lastly, there is the great colony of India where this plant is indigenous, and where it has been known for 3000 years. The evidence of Dr. Royle, the botanist of the East India Company, that India can yield an abundant supply of good and useful cotton, was quoted as a ground for the presumption that great blame attaches somewhere, since these expectations have never been realized except in a small degree at Guzerat. This part of the subject was closed by the remarkable statement that a piece of ground of the size of Yorkshire is sufficient to produce a quantity of cotton nearly double the annual consumption of England. It is not to be supposed that this trade is on the decline. One factory inspector—Mr. Horner, reports that in his district only, 81 mills were started during the year 1854, employing 14,000 hands. Mr. Bazley then examined minutely the probability of the further and future progress of this great industry, and the means to be adopted to insure it: but into this it will be impossible to follow him in a brief abstract like the present. He concluded by an enumeration of the objects of interest, both in the department of machinery and of fabrics connected with the Cotton Manufacture at the Great Exhibition: and with an expression of gratitude to his Royal Highness for having become the champion of arts, manufactures, and commerce, and to the Society of Arts for its share in promoting the success of the Exhibition.

A MACHINE TO PACK RAW COTTON.

In Africa, or other parts of the world, where hydraulic presses, or other complex contrivances, are not at command, any simple and efficient machine which would facilitate the firmly packing of cotton is a matter of considerable importance. The attention of Mr. James Nasmyth, of Patricroft, near Manchester, has been directed to this subject by Mr. Thomas Clegg, manufacturer, Brown-street; and Mr. Nasmyth has produced a design for a press, which appears in every respect well calculated to answer the object intended. In its mode of operation it is so simple that any "native" who can walk round and push the lever of a capstan can supply the power, while nine-tenths of the machine would be composed of wood, in order to avoid the difficulty which might occur in obtaining ironwork, or effecting

expended by the missionaries in setting the natives to gather and clean the indigenous produce, and to forward it as quickly as possible to England. At the same time they were directed to lay before the chiefs the advantageous opening which presented itself for the employment of their people, and how much better it would be to do that than to pursue their horrid traffic in slaves. The inducements held out proved sufficient to attract attention, and in the first year a few hundred pounds were collected. Mr. Clegg has spun a quantity of the cotton himself: in staple it is equal to Egyptian or good New Orleans, used in spinning fine yarns for the Nottingham and Leicester trade. The price of cotton suited for such fine numbers has more than doubled within a comparatively brief period; and what was selling at 9½d. a pound is now fetching 20d., and has been for some time.—*Manchester Examiner*.

repairs in that material. The design has been exhibited at the Royal Exchange, along with some African cotton; and Mr. Nasmyth generously offers the result of his skill to the public, stating, in his letter to Mr. Clegg, that he entertains a notion that such a simple and powerful press would be found useful in those foreign parts where the matter of packing is an important consideration. It would be somewhat difficult to give any description of the press which would be intelligible unaccompanied by a diagram; but we may state that it consists of a large wooden frame, which will hold a bale of cotton at each of its four corners. Across the machine runs a cog-rack, moved backward or forward by a central pinion, to be turned round like a capstan. The cotton to be packed is placed in two receivers, right and left of the rack, and at right angles to it; at the extremities of these receivers are the packing sheets, surrounded by cords (grooves being made in the woodwork to receive them). At the end of the rack are affixed two inclined bars, and as the rack is moved by the pinion those bars open out like the legs of a pair of compasses, and each forces the cotton into the packing-sheet at the extremity. The machine has a double action, and while two bales are being compressed at one end of it, the same motion liberates two packed bales at the opposite end, where fresh cotton is introduced to be in its turn compressed. As the bars move in parallel lines with each other, the pressure must be very considerable. At first the motion is rapid, which suits the easily compressible nature of the material; it then becomes slower, but of course what is lost in speed is gained in power, and gained, too, at the point when it is most required.—*Times*, Nov. 12.

NEW FLAX PROCESS.

A PROCESS of dressing Flax has been patented by Watt, in which steam is the only agent employed, and which, from its extreme simplicity and effectiveness, appears likely to supersede all others. The whole arrangements are inexpensive, and occupy but little space. The straw is placed in a steam-tight box, or chamber, of any size or shape; the top being formed by an iron tank containing cold water, and the lower end having a perforated false bottom fixed at about 12 inches from the other. Steam at a low pressure is blown into the box; and, passing up through the straw, comes in contact with the iron top, by which it is condensed; then, trickling down through the mass, it passes through the false bottom, carrying with it the extractive matter which it has dissolved out of the straw. This is continued for from eight to twelve hours. The straw is then removed, and is passed through four sets of rollers, which squeeze out about 80 per cent. of the water; and at the same time crush the stems, breaking up the central woody substance, and materially assisting its subsequent separation from the flax fibre. From these rollers it is carried to the drying-house, which is heated by steam pipes from the boiler, and thence to the scutching-frames, where the operation *is performed* more rapidly and efficiently than when the

flax is prepared by steeping, owing to the thoroughly crushed state in which it comes from the rollers.

The flax is then ready for market, having passed through the whole process of conversion in a very short space of time. This important improvement upon the other processes is being carried out by Messrs. Leadbetter, of Belfast, on an extensive scale. It is shown that the entire operation may be completed in 24 hours; that, on the average, 1 ton of straw will produce 2½ cwt., of dressed flax, and that the condensed liquor from the steaming-chest contains matter of a nutritious nature, having, according to analysis, a feeding value equal to distillery wash. This may be advantageously used by being poured, while hot, over the broken capsules or seed-bolls, which contain in themselves much nutritious matter, and in this state are readily eaten by cattle or pigs. The flax produced has already been sold at high prices, and has been pronounced by spinners to be of apparently unexceptionable quality.

The following are stated synoptically to be the advantages of this new process:—

1. Great saving of time.
2. Economy of fibre, owing to the facilities with which it is separated from the "shove," or woody centre, in the scutch-mill, thereby producing little waste in scutching tow, which latter is only worth from 6s to 10s. per cwt., while the long fibre from which it is torn away is worth from 50s. to 100s. per cwt.
3. Avoidance of any nuisance. Instead of the offensive products of the steep, an inodorous liquid is obtained, which may at once be consumed advantageously for feeding purposes.
4. The encouragement it will offer for the extension of Flax Cultivation throughout the country, by affording an opportunity to those who desire it of organizing at a small outlay an establishment which will always insure a ready market for the produce of the district.

Much good has already been done in this respect by the introduction into several districts of retteries on Schenck's system, those in operation purchasing directly from the farmer and steeping upwards of 30,000 tons in the course of the year. The new process, however, being able to complete the operation in a quarter the time required by the other, would, of course, be able to turn out four times as much work in a given time; and, as the arrangements would be less expensive in outlay, it offers an advantageous opportunity to all friends of Irish industry who wish to encourage the home cultivation of flax, and to retain in the country a portion, at least, of that large sum which is annually expended in purchasing the necessary supplies from foreign countries.—*Abridged from the Times.*

GIGANTIC FACTORY IN YORKSHIRE.

MR. TITUS SALT, of Bradford, has had built for him, at Saltaire, in the neighbourhood of Shipley, a stupendous Factory, to concentrate his scattered establishments for his Alpaca and Mohair manufactures. The area appropriated to the buildings is six acres; while the several floors in the mills, warehouses, and sheds form a superficies of 55,600 yards, or 11½ acres. The mill, which runs from east to west, is 550 feet in length, and 72 feet in height above the level of the rails. It includes

six storeys, and is constructed of massive stone work. The floors are formed on arches of hollow brick made on the ground by Clayton's patent process; the openings in the bricks being used for the purposes of ventilation. Rows of ornamental cast-iron columns and massive cast-iron beams support the arches. The roof is of iron. The windows of large size are filled with plate-glass. The whole of this building is fire-proof. From the centre of the mill running northward to the bank of the canal, a distance of 330 feet, are the warehouses, which at the lower end are 90 above the water. In the angle formed by the mill and warehouses to the eastward, comprising an area of 8400 yards, are the weft room and weaving shed, communicating with the several floors in the mill and warehouses by fire-proof hoists. The weaving shed will hold 1200 looms. The shafting runs in vaults under the floor, thus preserving the vast room above free from every obstruction. The corresponding angle on the western side of the warehouses is occupied by an immense shed for combing-machines; chambers for washing, drying, and sorting the wool; and by reeling and packing-rooms. Beneath this shed is an enormous filter and reservoir, capable of containing 500,000 gallons, into which the rain-water is conducted from the roofs, for scouring wool. The offices and store-rooms, extending to a length of 240 feet, with a very handsome façade, form the western boundary of the works. The arrangement, design, and construction of the buildings were confided to Lockwood and Mawson, architects of Bradford; the engines, boilers, and machinery, to William Fairbairn and Son, of Manchester. The engines consist of two pairs, nominally of 400 horse power. The boilers are constructed partly on the tubular principle, and placed beneath the level of the ground, to the southward of the mill, communicating with the chimney (250 feet high) at the eastern extremity of the works, to which is given the effect of an Italian campanile. The engine houses are situated on either side of the principal entrance to the mill; the engine-bed has required upwards of 1200 tons of solid stone. The engines are supplied with water by tunnel spassing below the canal, and communicating with the Aire. Another series of tunnels returns the water back to the river when used. A branch from the railway passes under the central arches of the mill, at which point there and at the north end, are hoists for loading and unloading. The gasworks, situated between the canal and the river, are upon White's hydrocarbon system, and are calculated to supply 100,000 ft. per day for 5,000 lights, in the mills, sheds, streets, and houses of the workpeople. 4500 hands are required to keep the works going. This will involve an addition to the population of Saltaire of from nine to ten thousand persons. To accommodate these, Mr. Salt proposes to erect forthwith 700 dwelling-houses of various classes, replete with every convenience for the health and comfort of the inhabitants. The architects are expressly enjoined to use every precaution to prevent the pollution of the air by smoke, or the water by sewerage or other impurity. Wide streets, squares with gardens, ground for recreation, a large dining-hall and kitchens, baths and washhouses, a

covered market, schools, and a church, are to form this industrial town. The cost of this gigantic undertaking is stated, in the *Bradford Observer*, at less than a quarter of a million of money.

RANSOME'S SILICEOUS STONE.

THERE has been introduced of late years a new kind of Artificial Stone, which, although perfectly plastic at one stage of the manufacture, is of perfectly uniform composition, entirely free from all shrinking and contortion during the process of kiln-drying, and bears exposure to winter temperatures and a moist atmosphere without any deterioration. This important immunity from so serious an evil it owes to the fact that no part of the material used in the construction consists either of lime or clay. It is, in fact, a siliceous or flinty stone, the particles of which it is made up (fine pure sand) being united together by a fluid which, after exposure to the kiln, becomes changed into a kind of glass. By the very nature of the case, therefore, this stone is secured from all injury from soot, acid, or other vapours, or disintegration by weather; and in many cases, where it has been actually exposed for several winters, it retains all its sharpness and surface perfectly. This material is called "Ransome's Patent Siliceous Stone."

The chemical fact on which the discovery of this stone is based is the perfect solubility of flint, or any siliceous material, when subjected to the action of caustic alkali (soda or potash) at high temperature in a steam boiler, or in cylinders communicating with such boilers. Flint, or silica, is a combination of oxygen gas with a peculiar base (silicium or silicon), and is technically an acid, though without the ordinary properties of acids. On being heated with caustic soda at a very high temperature, there is formed a thick jelly-like transparent fluid of pale straw colour, which is a hydrated silicate of soda, containing 50 per cent. of water; and which, if exposed to the air for a time or heated, loses a part of its water and solidifies into a substance capable of scratching glass.

The fluid silicate of soda having been obtained as described above, it is mixedwith sand and other material, (which may vary according to the required result,) and thus forms a kind of thick paste, moulded readily into any shape. Exposed for a time to the air, this gradually hardens by the evaporation of part of the water, and when put into a kiln the water is more rapidly and completely given off; the result being a perfectly solid mass, the original particles of sand being now cemented together by a kind of glass formed by the silicate of soda raised to a red heat. The whole amount of water in any given quantity of the unburnt stone does not exceed one-tenth part of its volume, but the total amount of contraction is extremely small and scarcely perceptible in any case. On the other hand, the contraction in terra-cottas is not only very considerable, requiring allowance to be made in moulding, but is also extremely irregular.

In consequence of the peculiarly simple composition of this new material, it has been found easy to manufacture of it porous as well *as compact stone;* and also such articles as grindstones and scythe-

stones (all of which enter into competition with natural stones) at a considerable advantage both in texture and price. The porous stones are peculiarly useful, as they make admirable filters; and by the simple precaution of placing a coating of fine pure white sand upon them they can never become choked. They are now extensively used, and are found to succeed admirably.

For pavements, balustrades, terrace works, vases, and generally for all purposes of garden decoration, this stone is well adapted by its cleanliness, sharpness of outline, colour, durability, and cheapness. For ornamental flooring in halls, churches, and public buildings, it possesses many advantages, and could be put down at little more than half the price of encaustic tiles of similar patterns. For quoins, cornices, battlements, chimneypots, and many other building purposes, it seems equally desirable; while for filters it is invaluable, and might be used to any extent in preference to any known natural filter stones.—*Times.*

NEW PLASTIC MATERIAL.

A Parisian sculptor, M. Duthoit, has obtained an English patent for a chemical combination of certain agents for obtaining a new product to be used in the Plastic Art. The patentee combines with gutta percha oxide of zinc, amianthus, and sulphate of baryta, in conjunction with various colours. The gutta percha is first prepared and bleached by being dissolved in rectified naphtha, bensole, or sulphuret of carbon. When the compounds do not possess sufficient elasticity, caoutchouc is added. The gutta percha being prepared, after filtration he places the solution in a still, adds the other ingredients, and stirs the whole well together. Heat is then applied until all the volatile oil is driven off, when the material is removed to the desired moulds. It is said to be suitable for numerous moulded works of art, tissues, or artificial flowers; it may be used as leather, when rolled into sheets; or it may be diluted with naphtha, or bensole, and employed as liquid paint.

NEW MODE OF TRANSPLANTING TREES.

A machine for raising and Transplanting Trees has been invented by Mr. Stewart M'Glashan, sculptor, Canonmills Bridge. It consists, in its simplest and smallest form, of two semi-cylindrical spades, hooked and eyed together at one part, but capable of being distended by lever power, so as to move the plant and its earth-ball. The larger forest-tree apparatus is the extension of this principle, with the addition of beams and distending-screws. The soil is cut all round, and lifted along with the root in a frame formed by the cutters, which, converging at the bottom, give the mass somewhat the shape of a wedge. The tree is attached to the frame near the bottom of the trunk by an iron clasp, and then lifted out by the aid of the screws, which are fixed to the frame; while a carriage, consisting of two common carts at either end, and connected by two parallel beams, is the means of

raising the whole. The tree can thus be conveyed any distance without the least injury.

DRAINAGE OF HAARLEM MEER.*

MR. GRAINGER, C.E., in a paper read before the Scottish Society of Arts, states that this great work is now nearly approaching its completion. The pumping was commenced in May, 1848, from which date to April 30, 1851, the lake had been lowered 7 feet 3 inches, which was the state of matters when the subject was last brought before the Society. During the months of May, June, July, August, September, and October, very satisfactory progress was made, notwithstanding that a considerable quantity of rain fell in August and September; the level reached at the end of October being 9 feet 7·74 inches below the original surface, or at an average rate of 4·79 inches per month. In November a great quantity of rain and snow fell, raising the level about 4 inches; and in December the weather was still unfavourable, so that at the end of that month the level stood at 9 feet 5·58 inches below the original surface, or a total gain, since April 30, of 2 feet 2·58 inches, or 3·32 inches per month. This progress may appear to be inconsiderable; but, when it is recollected that the lowering of the lake one inch involved the raising of upwards of four millions of tons of water, and allowing for the rain and snow falling during these eight months, there could not have been less than 186,000,000 tons of water pumped up during that period, the performance will appear great indeed. To give a better idea of this, it was stated that 186,000,000 tons is equal to a mass of solid rock one mile square and 100 feet high, allowing 15 cubic feet to a ton. The average progress has been less last year than it was in the preceding one; but this is readily accounted for by the *increased lift* of the pumps, and by the difficulty of forming the channels which lead the water to them. At the commencement of these operations, the average depth of the lake was 13 feet 1·44 inches, and as 9 feet 5·58 inches have been pumped out, there only remained at the end of December, 1851, an average depth of 3 feet 7·786 inches. It is, therefore, trusted that the drainage will be completed in the summer of 1853.

DRAINAGE OF TOWNS.

A PAPER on this subject has been communicated to the Institution of Civil Engineers, by Mr. R. Rowlandson. It was contended, that town sewers could not receive the excessive flood waters, even of the urban portion of the site; that they should never receive the suburban drainage, nor be combined with watercourses, that they should be adapted solely to remove the solid and liquid refuse from the houses; and that it was safer for the inhabitants that there should be no sewers at all, rather than they should be of such dimensions as to become places of deposit. Pumping could

* These stupendous Drainage Works are described in the *Year-book of Facts*, *1847, p. 34—38.*

be profitably adopted in certain situations, where from the level, or the effect of tidal influence, the outlet flow might be checked. Intercepting sewers at mid-level were approved. Sewers of mininum dimensions were advocated in connexion with pumping, and they should be capable of resisting internal hydraulic pressure in case of the water rising in them. The flow through sewers should be constant, and it was argued this could only be secured by having small conduits. With regard to earthenware pipes,—three inches diameter was considered too small for any drain pipes, and thirty inches diameter too large for the material of which they were made. Pipes of four inches diameter would probably be found the least sectional area that should be used for house drains, and nine inches for streets, and then not at a less gradient than one in sixty. It was decided that the beneficial use of pipe sewers could not be pushed beyond certain limits; but the system should not be entirely condemned because it had been carried to extremes by those who wanted experience. The general success of the use of egg-shaped pipe sewers at Manchester was given as an example of the advantageous adoption of the pipe system. The various kinds of joints were described, and it was recommended not to use pipes of larger diameter than about fifteen inches, as larger sizes were apt to be fractured from unequal bearing at the joints. The difficulty of moulding, drying, and burning pipes increased probably as the squares of the diameters; if large pipes were moulded too thin, they were liable to be crushed in the sewer; and if they were moulded of extra strength, the wet pipes collapsed with their own weight in drying, were twisted out of shape in burning, or were imperfectly vitrified. Sewers of radiated bricks, moulded for the purpose, were better and cheaper than earthen pipes: a sewer thus constructed, three feet in diameter, being cheaper than one of pottery pipe of twenty inches diameter,—their relative capacities being as the squares of their diameters; and there was no reason why brick sewers should not be as smooth within, and as impervious, as any pottery pipe.

After treating of side junctions, gulley holes, drain traps, and ventilation, the use of cast iron conduits, in certain bad soils, was advocated; and as a summary, it was stated, that all sewers should be below the level of the cellars, and should be specially adapted to the work they had to perform. Rivers and natural streams should not form part of any system of town drainage, and in low districts the sewers should be capable of resisting internal pressure. Free outlets should be preserved, whether from intercepting, or low sewers; all small drains should be circular, and large ones oval, or egg-shaped; the largest radius should be adopted, and there should be extra fall in the curves; all sewers and drains should be impervious to water, and should present even and smooth surfaces; the gradient of all large sewers in steep ground, should be modified, or interrupted; and the materials used, should be such as would resist rapid wear and bursting; wherever it was practicable, the outlet should be very free, and in all cases complete ventilation must be provided for. All mention of cesspools was omitted, as no locality could be considered as

properly drained, in which they were permitted to exist, except near the outlets, for ultimate use, for agricultural purposes.

The true purpose of Town Sewerage must be considered, as the removal, with the utmost rapidity, from the vicinity of dwelling houses, and the sites of cities and towns, all the refuse, which being liable to decomposition, could be conveyed away in water; and the more perfectly this could be accomplished, the better would be the work, and the greater the credit due to the engineer.

The reading of this paper was followed by a protracted discussion of three nights' duration, in which pipe-drainage was strongly denounced, and the superiority of roomy brick sewers advocated. On the other hand, the advocates of the new school cited Manchester, with its nearly 70 miles of pipe-drainage; Rugby, Itchen, and other towns, similarly provided, as well as the 300 or 400 miles of pipe-drainage laid in the metropolis: and one firm had manufactured weekly, 18,000 yards of earthenware pipes. It was admitted that the Board of Health could not maintain the asserted superiority of the small pipe drain system, even to the extent still attempted; the present doctrine being not to construct any drain larger than, as was alleged, would be able to relieve a district of its ordinary sewage, without regard to the contingency of storms, and the necessity of internal inspection. Lastly, the dictatorial system pursued by the Board of Health was complained of as leading to the sanction of plans to a greater extent than was approved by the engineers who were charged with the responsibility of the works.

RUGBY WATER SUPPLY AND DRAINAGE.

In these New Works, constructed under the Public Health Act, the most conspicuous object is a high Water-tower, containing a Tank to supply the town during Sunday, or in case of fire, or in the night; to give pressure in the distribution of the water, and avoid the necessity for continuous pumping. Next is an under-ground reservoir, covered with groined arches. Deep drains have been cut into gravel, and the water may be drawn off at will, as from a reservoir, for the supply of the town. The property of the water, in respect of hardness, is said to be equal to eight degrees; while that of the existing town wells varies from sixteen to twenty and even thirty degrees, and that of the streams in the neighbourhood is generally of eighteen degrees. In the drainage works, the sewers are of impermeable stoneware tubes. In several cottages, the cesspools have been filled up, and a water-closet apparatus substituted. The water service-pipes are of tin. The average expense of improvements for each cottage, it is estimated, might be repaid in the shape of a private improvement rate of about ¾d. a week.

DRAINAGE OF RICHMOND.

A paper has been read to the Institution of Civil Engineers, describing the Drainage of the town of Richmond, Surrey, under the authority of the Metropolitan Commissioners of Sewers, in 1851; by *Mr. George* Donaldson, Assoc. Inst. C. E.

The drainage of Richmond, extending over an area of about 320 acres, was undertaken by the board in the year 1849, on the application of some of the principal inhabitants; when the author was appointed to report on its then state, and to propose some general plan for its improvement. At that period, all the sewage was collected into cesspools, the liquid contents of which were allowed to drain into the earth; causing offensive exhalations from its surface, and contaminating the water in the adjacent wells, from which a large portion of the house water-supply was drawn, whilst the cesspools themselves were seldom emptied. In many of the streets, however, there were brick drains, which had been from time to time constructed, for carrying off the surface and storm waters; but these were not deep enough to receive the house drainage, which it was determined to effect by means of tubular stoneware pipes, entirely independent of, and separate from, the brick drains, thus practically carrying out a system on which very different opinions had been entertained. At present the outfall of the sewerage was into the Thames, near the railway bridge; but eventually a main outfall sewer was to be constructed to connect Richmond with the general system of sewerage of the metropolis. The pipe sewers were about 50,000 feet in length, executed at a cost of about £7500, rather more than half consisting of minor, or branch sewers. The branch pipes, as far as the kerb of the foot pavement, were laid down at the same time as the main pipes; each junction being formed at an acute angle, and so arranged as to receive the drainage of three houses. Before being laid in the trenches, the pipes were fitted together and marked, and afterwards packed solidly round with earth. In some of the wet sand beds it was considered advisable to lay the pipes on 2-inch deals, four inches deep, fastened to stakes. The joints were made with well-tempered clay and cement, and it was very important that they should be water-tight, otherwise one of the chief advantages of pipe sewers over brick drains would be lost. After their completion, the pipes were proved, by allowing a flush of water to pass through each separately for about fifteen or twenty minutes. All the inlets to the house drains were trapped with syphons, or bell-traps; and the works generally have been perfectly successful.

In the discussion which ensued, the comparative merits of the systems of separating the storm water from the house sewerage, and of combining them in large sewers, were argued at great length. It was admitted, that the separate system had not yet been tried for a sufficient length of time, to arrive at definite results; but, as far as experience had hitherto gone, there was a general impression in favour of the combined system in main sewers of brick, not less than four feet high, in order, not only that men should pass easily up them, but that they should be able to work in them. The pipe drains, even of 21 to 24 inches diameter, were liable to be choked by deposit; and their areas had been so reduced, even where the separate system had been employed, that stoppages had continually occurred; thus proving that the exclusion of road-drift

was not entirely efficacious. It was shown also, that whenever it was necessary to cut into the pipe drains, there was great injury from breakage, and they were ultimately more expensive than brick drains.—*Proceedings of the Institution of Civil Engineers.*

SELF-SUSTAINING SYSTEM OF SEWAGE REMOVAL.

MR. T. A. YARROW, C.E., has been engaged to report upon the drainage of Coventry; and in a pamphlet, developing a plan for saving the Sewage of towns and applying it to agricultural purposes, he says:—"The means I propose to adopt are those suggested by Prince Albert, consisting of a rapid filter of peculiar construction; and the deodorant and absorbent employed in the process is peat charcoal, now produced at small cost from the bogs in Ireland. The plan consists of an application of the sewage filter at the outlet of the main sewer, by means of which sewage will be deprived of its colouring and offensive matter, and made to pass off in a perfectly clear state. After a certain time the charcoal in the filter will require to be renewed, when a little granulated charcoal must be added to the solid matter retained in the tank; and in a few minutes the whole mass will assume the form of a dry, portable, and inodorous manure, ready for packing in barrels or sacks, and capable of being transported by any mode of conveyance."

PREVENTION OF WATER-PIPES BURSTING BY FROST.

MR. A. MACPHERSON, F.R.S.S.A., has contributed a paper to *Jameson's Journal*, descriptive of a self-acting Apparatus for the Prevention of the Bursting of Water-Pipes during Frost. The supply-pipe from the main source rises from the ground, forming a curve into a double-action valve-box: this supply-pipe is continued into the cistern, which should be above; and a waste-pipe carries the extra water off when the supply is stopped. Under the valve-box is a copper-tube, containing a measured quantity of water, in which works a piston accurately fitted, and passing through a stuffing-box, it acts upon the valve. A strong air vessel is fitted over the bend of the supply-pipe. If frost acts on the small copper tube, the water in it will be the first to freeze, expand, and elevate the piston, which pushes up the valve from its seat, and shuts it with great force against the projecting extremity of the ingress supply-pipe. The connexion being now open between the continuation-pipe to the cistern and the waste-pipe, the water contained in them descends into the drain; while the air-vessel allows of expansion for the water to freeze in the supply-pipe now closed. When the water becomes again liquid, the whole pressure is exerted to depress the valve, shut down the piston, and open the supply-pipe.

MANUFACTURE OF PEMMICAN.

SIR JOHN RICHARDSON thus describes his manufacture of this new Provision for Arctic exploration. The round or buttock of beef, of the best quality, having been cut into thin steaks, cleared of the fat and membranous parts, was dried in a malt-kiln over an oak fire,

until its moisture was entirely dissipated, and the fibre of the meat became friable. It was then ground in a malt-mill, when it resembled finely-grated meat. Being next mixed with nearly an equal weight of beef suet or lard, the preparation of plain Pemmican was complete; but, to render it more agreeable to the unaccustomed palate, a proportion of the best Zante currants was added to part of it, and part was sweetened with sugar. After the ingredients were well incorporated by stirring, they were transferred to tin canisters, capable of containing 85lb. each; and having been firmly rammed down, and allowed to contract further by cooling, the air was completely expelled and excluded by filling the canister to the brim with melted lard, through a small hole left in the end, which was then covered with a piece of tin, and soldered up. Finally, the canister was painted and lettered according to its contents. The total quantity of Pemmican thus made was 17,424 lb., at a cost of 1s. 7½d. a pound. But the expense was somewhat greater than it would otherwise have been, from the inexperience of the labourers, who required to be trained, and from the necessity of buying meat in the London market at a rate above the contract price, occasioned by the bullocks slaughtered by the contractor for the naval force at Portsmouth being inadequate to the supply of the required number of rounds.

As the meat in drying loses more than three-fourths of its original weight, the quantity required was considerable, being 35,651 lb.; drying reduced, reduced to about 8000 lb.; and the sudden abstraction of more than one thousand rounds of beef from Leadenhall market occasioned speculation among the dealers, and a rise in the price of a penny per pound, with an equally sudden fall when the extra demand was found to be very temporary.

The natives dry their venison by exposing the thin slices to the heat of the sun, on a stage, under which a small fire is kept, more for the purpose of driving away the flies by the smoke than for promoting exsiccation; and then they pound it between two stones on a bison hide. In this process the pounded meat is contaminated by a greater or smaller admixture of hair and other impurities. The fat, which is generally the suet of the bison, is added by the traders; and they complete the process by sewing up the pemmican in a bag of undressed hide with the hairy side outwards. Each of these bags weighs 90 lb., and obtains from the Canadian voyagers the designation of "a taureau." A superior Pemmican is produced by mixing finely powdered meat, sifted from impurities, with marrow fat, and the dried fruit of the Amelanchier. Sir John Richardson states the cost of 17,424 lb. of Pemmican thus manufactured to have been £1,396 11s. 11d.; average cost per pound, 1s. 7¼d.

APPLICATION OF RECTIFIED OIL OF COAL-TAR TO THE PRESERVATION OF MEAT AND VEGETABLES.

M. Robin states, when the flesh of animals, entire birds with the feathers, vegetables, fruits, &c., are placed in air-tight vessels filled with water, at the bottom of which there is a little Oil of Coal-tar, so that *the substances to be* preserved are covered by the water, which

becomes charged with the vapour of the oil evaporating at the ordinary temperature, they are perfectly preserved from decomposition.—*Comptes Rendus*, vol. xxxii., p. 650.

INSTITUTION OF CIVIL ENGINEERS.

At the Annual General Meeting of this Institution, Dec. 21, 1852, the Report attributed the present extraordinary activity in public works and private enterprises, in a great degree, to the discovery of those auriferous deposits of the other hemisphere, which had been, apparently, beneficently designed, to bring into active utility the humbler, but more permanently useful minerals of the parent country.

It alluded to the general demand for the improvement of the sanatory condition of towns, the completion of the branch lines of railways; the extension of the electric telegraph to the Continent, and to India, and the vast revolution it was producing in commercial and social relations. The augmented size of steam-vessels, and the creation of docks of proportions to receive them; the rapid accomplishment of the railway across the Isthmus of Panama, with the recent survey for a projected ship canal, in the same region; and the numerous other works, in all parts of the world, confided to the skilful conduct of English Civil Engineers; were briefly alluded to; whilst the good wishes of the profession were demanded for the re-establishment of the building, in which the specimens of the world's wealth had first been exhibited, and which was now to be devoted to the recreation and instruction of that valuable portion of society, the productive classes.

The Council have awarded the following premiums:—Telford Medals, in Silver, to Capt. Mark Huish, for his paper "On Railway accidents,"—Braithwaite Poole, Esq., for his paper "On the Economy of Railways,"—Col. Samuel Colt, for his paper, "On the Application of Machinery to the Manufacture of Rotating Chambered-breech Fire-arms, and the peculiarities of those Arms,"—Frederick Richard Window, Esq., for his paper "On the Electric Telegraph, and the principal improvements in its construction,"—Charles Coles Adley, Esq., for his paper entitled "The History, Theory, and Practice of the Electric Telegraph,"—M. Eugène Bourdon, for his "Description of a new Metallic Manometer, and other Instruments for Measuring Pressures and Temperatures,"—M. Pierre Hippolyte Boutigny, for his "Description of a new Diaphragm Steam Generator,"—and George Frederick White, Esq., for his "Observations on Artificial, or Portland Cement:"—Council Premiums of Books, suitably bound and inscribed,—to John Baldry Redman, Esq., for his paper "On the Alluvial Formations, and the Local Changes, of the South-Eastern Coast of England, from the Thames to Portland,"—William Thomas Doyne, Esq., and Professor William Bindon Blood, for their paper, entitled "An Investigation of the Strains upon the Diagonals of Lattice Beams, with the resulting Formulæ,"—George Donaldson, Esq., for his paper "On the Drainage and Sewerage of the Town of Richmond,"—Professor Christopher Bagot Lane, for his "Account of the Works on the Birmingham Extension of the Birmingham and Oxford Junction Railway," —and William Bridges Adams, for his paper "On the Construction and Duration of the Permanent Way of Railways in Europe, and the modifications most suitable to Egypt, India, &c."

Memoirs were read of F. M. the Duke of Wellington, Major-General Colby, and John George Children, honorary members; Messrs. John Barnes, David Bremner, Robert Brunton, William Tierney Clark, Frank Forster, Thomas Grainger, and Walter Hunter,

members; Sir John Josiah Guest, bart., M.P., John Sylvester, and Henry Vint, associates; and Henry Charles Rasonsley, graduate.

The condition and progress of the Institution were described as most satisfactory. The number of Members, of all classes, was 746.

The session of the Institution was terminated by a Conversazione on May 25. The rooms were profusely decorated with works of art, models of machinery, and specimens of manufacture. Among the numerous collection of models, many were shown at work. Among these may be noticed the anastatic process of printing exhibited by Messrs. Glynn and Appel; who had recently introduced a method of preparing paper by the addition to it, while still in a state of pulp, of an insoluble salt of copper, and a peculiar preparation of palm oil, so that when an attempt was made to reproduce any document, it became fixed to the plate, and no transfer could be made. Messrs. Napier and Son exhibited an Automaton Sovereign Weighing Machine, which differed from those now in use at the Bank by its separating the coin into three classes, the too light,—those between certain limits, which might be variable, and the too heavy,—instead of simply into the light, and the full. They also exhibited a Captain's Registering Compass, which showed at a glance the exact course the ship had taken, and the moment when any deviation from the true course had been made. Mr. W. S. Lacon explained a model illustrative of his ideas as to the management of ships' boats, how they should be steered, and suspended, and lowered in case of emergency, an important desideratum. Mr. S. Highley's Achromatic Gas Microscope Lamp, a contrivance for combining, or rather modifying the glaring light common to ordinary gas microscopic burners when making researches, was an object of great interest. There were also many models in various branches of engineering; Messrs. Maudslay and Messrs. Penn contributing models of almost every kind of marine engine; and to Capt. Henderson was due the collection of a vast number of different kinds of vessels for the purpose of showing the great discrepancy that existed in different countries in the lines of ships. In Railways, permanent way seemed to be the point to which inventors chiefly devoted their thoughts; and the various modifications of Mr. W. H. Barlow for a road entirely of wrought iron,—of Mr. Henson for a similar rail supported by longitudinal timbers,—and of Messrs. P. W. Barlow, Greaves, Doull and Reed, for chairs and supports of cast iron, so as to make the road partly of cast, and partly of wrought, but still entirely of iron,—were shown. Mr. Henson contributed a model of his covered railway goods waggon, by which it was said a saving of at least fifty per cent. in repairs alone over the old waggons with sheets would be effected. —*Athenæum*, No. 1315.

FOURTH ANNUAL EXHIBITION OF INVENTIONS AT THE SOCIETY OF ARTS.

This Exhibition, opened in December, 1852, was arranged under six principal heads: 1. Motive Machines, including Railway Mechanism; 2. *Manufacturing Machines* and Tools; 3. Building Contrivances and

Materials, and Navy and Military Mechanism; 4. Philosophical Instruments and Hardware; 5. Agricultural Implements and Saddlery; 6. Miscellaneous, including articles for personal use.

In the first class some Electro-magnetic Machines for use as prime movers, invented by M. Froment, of Paris, were exhibited by M. Fontaine moreau. The means employed to obviate the difficulties hitherto experienced in the use of this fluid as a motive power are proposed to be overcome by causing the magnet to come into action as soon as its keeper approaches it. This is accomplished by means of an eccentric. A drawing of Mr. M'Connell's Express Engine attracted much attention, as combining the most recent improvements in the construction of locomotive engines. Mr. J. Rock, jun., exhibited an improved Railway Luggage Van for facilitating the removal of the tarpauling, at present an extremely inconvenient and laborious operation; also his modifications of Steam-engines applicable to agricultural purposes, and for facilitating the turning of the engine on the field, and the distribution of manure were likewise shown. There were some beautiful specimens of a new Terra Cotta, by J. M. Blashfield, which appeared to be capable of assuming the most delicate shapes, and to be suitable for ornamental and building purposes generally. It is said that this material will not only resist the action of the atmosphere, but even become harder on exposure to it; and should it be produced at a cheap rate, there can be no doubt it will be extensively used. Gold-washing machines were exhibited in several varieties; they possessed many points in common, namely a revolving cylinder and dashers for washing the soil and obtaining the auriferous deposit free from earthy impurities. The tools were constructed in such a manner that by a very simple operation the shovel became a scraper, and the handle of the shovel a portion of a crowbar, pickaxe, &c.

THE PANOPTICON IN LEICESTER-SQUARE.

This building is nearly completed externally, and the interior arrangements are rapidly progressing. In a chamber opening into the first gallery, opposite the main entrance, and separated from the gallery by a large screen (upon which dissolving views and other optical demonstrations will be projected), a huge organ will be constructed by Willis and Co. In the basement will be placed the ponderous machinery, for the working of which the place affords peculiar facilities; especially for experiments on railway machines, the speed of engines, the resistance of the atmosphere, &c., which at present can only be tried on existing lines by the favour of directors. Around the basement a circular line of rails is laid, of the gauge common in actual practice, so that a carriage or train of carriages can be worked upon it at any required speed with perfect convenience. In addition to other great works going on here, is an electrifying machine of the flat construction, stated to be the largest ever made. The plate has been made by the Thames Plate Glass Company, and is about 8 feet in diameter. This work is going on in a spacious chamber, which will hereafter be used as a chemical laboratory. The theatres for the delivery of lectures are spacious and well designed for public convenience. From the galleries of the interior, its architectural effect to the eye is remarkably fine. The establishment will be under the able direction of Mr. E. M. Clarke.

We may here notice that Mr. Wyld's Great Model of the Earth, in Leicester Square, has been improved by additional Illustration of the Circumpolar Regions. The model is detailed in the *Year-Book of Facts, 1852, pp. 96, 97.*

Natural Philosophy.

PENDULUM EXPERIMENT.

Mr. Bunt has repeated M. Foucault's experiment in his own house at Bristol, and endeavoured to ascertain with what degree of accuracy it may be performed on a comparatively small scale, and at a much less expense of time and labour than he had bestowed on it on a former occasion. He accordingly suspended, in different parts of his house, three different pendulums, and the results of the experiments made with each of them have been communicated by Mr. Bunt to the *Philosophical Magazine*, No. 25, with the following

Mean of all.

Total time.	Total motion.	Motion per hour.
h m 54 49·6	° 643·9	° 11·744
Deduct to reduce $b=0$		·066
Mean motion per hour from this series		11·678

THE GYROSCOPE.

By the ingenious means discovered by M. Foucault, of making visible the rotation of the earth; the plane of vibration of the pendulum, as seen by a spectator on the earth's surface, which had been hitherto supposed to be stationary, was found to move slowly round the fixed point as a centre from east to west. M. Foucault has now invented an instrument of moderate compass by which not only the rotation of the earth, but the position of the poles may be demonstrated with comparatively little difficulty.

By means of the Gyroscope any person may find his latitude by direct observation of the position which the axis of the instrument assumes parallel to the axis of the earth: so that the observer may thus create for himself an artificial equator, just as by the level of water he may find an artificial horizon.

"The apparatus of M. Foucault is a raised disc, or rather a small flat barrel of bronze, made as homogeneous as possible, and better balanced upon its axis by the addition of some adjusting screws, which make its centre of gravity exactly coincide with its centre of figure. The axis of the disc, made of tempered steel, is terminated by two conical points, working without friction, in the ends of two screws. Upon this axis is attached a small pinion, which can be connected with the teeth of a wheel capable of giving a very rapid motion to the disc, amounting to as much as 150 revolutions per second. The instrument by means of which the disc may be put in rotation need not be described; for any system of toothed wheels may produce this effect, provided that it has a wheel capable of entering into gear with the pinion of the disc, and that it moves with sufficient rapidity. The centre contains a flat disc, carrying a plate of glass with parallel faces, or a

metallic mirror, to enable the fixed plane of rotation of the moving body to be exactly observed and adjusted by aid of a distant fixed object. The disc and its axis are supported by a cylindrical ring, of which the axis of the disc occupies one of the diameters. In this ring are placed the conical holes or sockets, which fit the two parts of the axis of the disc, which may by this arrangement be more or less restrained in its motion. Above the screws of the sockets, the ring carries vertical screws with moveable nuts, which, conjointly with the horizontal screws, serve to restore the equilibrium of the whole system when placed on the knife-edges, of tempered steel, which are fixed on the outside of the ring at the extremity of its diameter, perpendicular to that which contains the axis of rotation of the disc. These knife-edges in the plane of the middle section of the ring may be placed upon two plates of agate, which carry a third ring which is the exterior one of the system. The different parts of the apparatus which we have described may be brought by trial to a state of neutral equilibrium, so that the knife-edges resting on plates perfectly level, whatever may be the position given to the disc round its axis, the ring which carries it, maintains itself always in the horizontal plane. The circle or exterior cylindrical ring is so placed that the plates of agate for supporting the knife-edges are on its horizontal diameter, while its vertical diameter contains the apparatus of suspension which gives it such great mobility. This apparatus of suspension is composed of a hook, fixed in the upper part of the ring, by which it is suspended from a silken thread without torsion, and protected by a vertical tube from the immediate action of exterior disturbances, and attached to a screw, which allows the ring to be raised little or much as may be desired. The stem of the hook passes through a double cushion, the upper part of which, at the same time, gives the means of fixing the ring on any azimuth. It must be well understood that there is no friction of the stem in the cushion, and that the latter is only there to prevent the oscillatory movement of the ring. The lower part of this ring has a conical plate, which moves in a socket, without, however, touching it; for it has the same object as the upper cushion—that is, to prevent the vibration of the ring. The whole of these parts are supported by the solid exterior half-circle, which is supported by a screw foot, by the aid of which the thread and the great ring may be put in a perfectly vertical plane. The disc and its ring can easily be drawn back from off the plates of agate of the exterior circle, and applied to the apparatus for putting the disc in rotation. This done, and the parts replaced in the exterior circle, the phenomena due to the parts of the plane of rotation, as seen by a spectator revolving with the earth, will immediately begin to manifest themselves. To measure the displacement of the large circle in relation to the observer, there are on the exterior surface of the large ring divisions corresponding to degrees, minutes, and seconds, of a horizontal circle, which has for its centre that of the system; and for its radius the distance of that centre from the place occupied by the divisions, which are opposite the knife-edges of the interior circle. With the aid of a microscope the smallest displacement of the divisions of the circle may be seen by means of a fixed thread stretched in the focus of the eye-piece. With this adjustment, it is easy to observe the angular motion of the circle proportional to the size of the latitude. If, instead of placing the knife-edges on the plates of agate, we put there the heads of the screws which carry the axis of the disc so as to prevent all side motion of the interior circle, we shall immediately observe the phenomenon of a westerly motion taking place in the instrument, of which the great circle will fix itself with the plane of rotation of the disc in the prime vertical—*i.e.* the vertical plane perpendicular to the meridian, whilst the axis of the disc stops in the plane of the terrestrial meridian itself. But if, on the contrary, the interior circle is replaced with the edges on the plates of agate, and with the aid of the curb, the large exterior circle is fixed in the prime vertical, whilst the axis of the disc is in the meridian, the inclination will directly manifest itself, and the interior circle turn on the knife-edges until the axis of rotation of the moveable body becomes parallel to that of the earth, and the kind of motion of the disc coincides with that of the rotation of the terrestrial spheroid.

"Such is the ingenious apparatus invented by M. Foucault, and constructed by him, by the aid of which, in any part of the world, without aid of stars or compass, and without even measuring the number of vibrations of the free pendulum devised for that purpose by him, and brought to so great perfection by our *English experimenters*, the position of the earth's axis and the plane of the

equator may be determined by actual and immediate observation; in a word, an artificial axis, a sort of dynamical needle, may be constructed so as in all positions and in all climates, and with unerring certainty, to point direct to the pole."[*]—*Literary Gazette*, No. 1868.

EFFECT OF THE EARTH'S ROTATION ON LOCOMOTION.

MR. URIAH CLARKE, of Leicester, has called attention in the *Mechanics' Magazine* to the influence of the Earth's Rotation on Locomotion. It is well known that as the earth revolves on its axis once in twenty-four hours, from west to east, the velocity of any point on its surface is greater nearer the equator and less farther from it in the ratio of the co-sine of the latitude. Mr. Clarke states: "Some rather important conclusions in relation to railway travelling arise out of the view now taken. The difference between the rotative velocity of the earth in surface motion at London and at Liverpool is about twenty-eight miles per hour; and this amount of lateral movement has to be gained or lost, as respects the locomotive, in each journey, according to the direction we are travelling in from one place to the other; and in proportion to the speed will be the pressure against the side of the rails, which, at a high velocity, will give the engine a tendency to climb the right hand rail in each direction. Could the journey be performed in two hours between London and Liverpool, the lateral movement or rotative velocity of the locomotive would have to be increased or diminished at the rate of nearly one-quarter of a mile per minute, and that entirely by side pressure on the rail, which if not sufficient to cause the engine to leave the line, would be quite sufficient to produce violent and dangerous oscillation. It may be observed, in conclusion, that as the cause above alluded to will be inoperative while we travel along the parallels of latitude, it clearly follows that a higher degree of speed may be attained with safety on a railway running east and west than on one which runs north and south." There is no doubt of the tendency Mr. Clarke speaks of on the right-hand rail, but we do not think it will be found to be so dangerous as he says. It will be the greatest on the Great Northern and Berwick lines, and least on the Great Western.—*Railway Times.*

RE-CONCENTRATION OF THE MECHANICAL ENERGY OF THE UNIVERSE.

MR. RANKINE, in a paper read by him to the British Association, observes that it has long been conjectured, and is now being established by experiment, that all forms of physical energy, whether visible motion, heat, light, magnetism, electricity, chemical action, or other forms not yet understood, are mutually convertible; that the total amount of physical energy in the universe is unchangeable, and varies merely its condition and locality, by conversion from one form to another, or by transference from one portion of matter to another. Prof. W. Thompson has pointed out, that in the present condition of the known world there is a prepon-

[*] For Abstracts of M. Foucault's results, as well as of several other physicists, see the *Year-Book of Facts*, 1852, pp. 86—96.

derating tendency to the conversion of all the other forms of energy into heat, and to the equable diffusion of all heat; a tendency which seems to lead towards the cessation of all phenomena, except stellar motions. The author of the present paper points out that all heat tends ultimately to assume the radiant form; and that, if the medium which surrounds the stars, and transmits radiation between them, be supposed to have bounds encircling the visible world, beyond which is empty space, then at these bounds the radiant heat will be totally reflected, and will ultimately be re-concentrated into foci; at one of which if an extinct star arrives, it will be resolved into its elements, and a store of energy reproduced.

THERMAL EFFECTS OF AIR RUSHING THROUGH SMALL APERTURES.

PROF. THOMAS has submitted to the British Association the results of a set of experiments lately undertaken by Mr. Joule, at his suggestion, and partly with his assistance, and as many of the details as time would permit. He commenced by explaining Mr. Joule's original idea that all mechanical action could be reduced to an equivalent of heat; and that his first determination led to the conclusion that a difference of 170°, afterwards corrected to 172°, was equivalent to 1 lb. raised 1 foot in a second, thus affording the mechanical unit of heat. He then explained Meyer's hypothesis, stating that the object of the experiments undertaken by Mr. Joule and himself was, to test the accuracy of this. In these experiments air had been forced to pass by the action of a condensing pump rapidly through small apertures, and through spiral tubes of small diameter, surrounded by water: heat was developed by the friction. but cold afterwards resulted from the expansion, and the object was to ascertain which of these preponderated. But the experiments required such accuracy of adjustment of the position of the thermometer, and were affected by so many circumstances, that the results were not satisfactory. It then occurred to Mr. Joule to force the air through the pores of a diaphragm of leather on it, to allow it then to expand into a tube of vulcanized india rubber, surrounded by water; and in this arrangement it was found that the thermometer could be brought down nearly into contact with the leather diaphragm. But although these experiments also led to the conclusion that rather more heat was generated by the compression and friction than was afterwards consumed in the expansion, yet many causes, such as the rapid transmission of heat through the india-rubber tube, &c., tended to render the results, which depended on very minute differences, doubtful. He exhibited diagrams of the apparatus employed and tabulated details of the experiments; and concluded by expressing a hope that some of the money placed by Government at the disposal of the Royal Society for aiding scientific research would be appropriated to enabling them to carry on these experiments on a large scale; and to use pumps worked by steam-power instead of small hand-pumps to force large quantities of air rapidly through the small apertures,—of which the friction was to be tested.—*Athenæum*, No. 1299.

THE BOOMERANG. BY J. E. GRAY.

If a common manilla or palm-leaf hat having a low crown, and the margin of the rim sharply turned up about half an inch high, is thrown into the air with the cavity of the hat upwards, it returns back towards the thrower like the Australian Boomerang. The angle at which it returns depends on the angle at which it is thrown ; and if the angle is sufficiently acute, it will fall some distance behind the thrower. The experiment depends on the position of the hat ; for it thrown with the cavity downwards, it alights in the direction thrown, and does not return. A pasteboard disc with a turned-up edge has the same effect as a hat.—*Philosophical Magazine*, No. 22.*

DIVISIBILITY OF MATTER.

Many years ago, a curious calculation was made by Dr. Thomson, to show to what degree matter could be divided, and still be sensible to the eye. He dissolved a grain of nitrate of lead in 500,000 grains of water, and passed through the solution a current of sulphuretted hydrogen, when the whole liquid became sensibly discoloured. Now a grain of water may be regarded as being about equal to a drop of that liquid, and a drop may be easily spread out so as to cover a square inch of surface. But under an ordinary microscope, the millionth of a square inch may be distinguished by the eye. The water, therefore, could be divided into 500,000,000,000 parts. But the lead in a grain of nitrate of lead weighs 0·62 grain ; an atom of lead accordingly cannot weigh more than 1-310,000,000,000th of a grain ; while the atom of sulphur, which in combination with the lead rendered it visible, could not weigh more than 1-2,015,000,000,000, that is the two-billionth part of a grain.

But what is a billion, or rather, what conception can we form of such a quantity ? We may say that a billion is a million of millions, and can easily represent it thus :—1,000,000,000,000. But a schoolboy's calculation will show how entirely the mind is incapable of conceiving such numbers. If a person were able to count at the rate of 200 in a minute, and to work without intermission twelve hours in the day, he would take to count a billion 6,944,444 days, or 19,025 years 319 days. But this may be nothing to the division of matter. There are living creatures so minute, that a hundred millions of them might be comprehended in the space of a cubic inch. But these creatures, until they are lost to the sense of sight, aided by the most powerful instruments, are seen to possess organs fitted for collecting their food, and even capturing their prey. They are, therefore, supplied with organs, and these organs consist of tissues nourished by circulating fluids, which circulating fluids must consist of parts or atoms, if we please so to term them. In reckoning the size of such atoms, we must speak not of billions, but perchance of billions of billions. And what is a billion of billions ? The number is a quadrillion, and can be easily represented thus :— 1,000,000,000,000,000,000,000,000 ; and the same schoolboy's cal-

* See the application of the principle of the Boomerang to the propelling of vessels *at page 33 of the present volume.*

culation may be employed to show that to count a quadrillion at the rate of 200 in the minute, would require all the inhabitants of the globe, supposing them to be a thousand millions, to count incessantly for 19,025,875 years, or for more than 3000 times the period for which the human race has been supposed to be in existence.—*Professor Low, in Jameson's Journal,* No. 106.

SOURCES AVAILABLE TO MAN FOR THE PRODUCTION OF MECHANICAL EFFECT.

MEN can obtain Mechanical Effect for their own purposes either by working mechanically themselves, or directing other animals to work for them; or by using natural heat, the gravitation of descending solid masses, the natural motions of water and air, and the heat, or galvanic currents, or other mechanical effects produced by chemical combination, but in no other way at present known. Hence, the stores from which mechanical effect may be drawn by man belong to one or other of the following classes:—

I. The food of animals.
II. Natural heat.
III. Solid matter found in elevated positions.
IV. The natural motions of water and air.
V. Natural combustibles (as wood, coal, coal-gas, oils, marsh gas, diamond, native sulphur, native metals, meteoric iron).
VI. Artificial combustibles (as smelted or electrolytically deposited metals, hydrogen, phosphorus),

In the present communication (to the Royal Society of Edinburgh, by Professor William Thomson,) known facts in natural history and physical science, with reference to the sources from which these stores have derived their mechanical energies, are adduced to establish the following general conclusions:—

1. Heat radiated from the sun (sunlight being included in this term) is the principal source of mechanical effect available to man.* From it is derived the whole mechanical effect obtained by means of animals working, water-wheels worked by rivers, steam-engines, and galvanic engines, and part at least of the mechanical effect obtained by means of windmills and the sails of ships not driven by the trade-winds.

2. The motions of the earth, moon, and sun, and their mutual attractions, constitute an important source of available mechanical effect. From them all, but chiefly, no doubt, from the earth's motion of rotation, is derived the mechanical effect of water-wheels driven by the tides. The mechanical effect so largely used in the sailing of ships by the trade-winds is derived partly, perhaps principally, from the earth's motion of rotation, and partly from solar heat.

3. The other known sources of mechanical effect available to man are either terrestrial—that is, belonging to the earth, and available without the influence of any external body,—or meteoric,—that is,

* *A general conclusion* equivalent to this was published by Sir John Herschel *in 1833. See his* Astronomy, edit. 1849, § (399).

belonging to bodies deposited on the earth from external space. Terrestrial sources, includin gmountain quarries and mines, the heat of hot springs, and the combustion of native sulphur, perhaps also the combustion of all inorganic native combustibles, are actually used; but the mechanical effect obtained from them is very inconsiderable, compared with that which is obtained from sources belonging to the two classes mentioned above. Meteoric sources, including only the heat of newly fallen meteoric bodies, and the combustion of meteoric iron, need not be reckoned among those available to man for practical purposes.

HEIGHT OF WAVES.

MR. T. STEVENSON, F.R.S.E., states, in a letter to Professor Emmerson, that so far as his own observations have gone, Waves seem to increase in height most nearly *in the ratio of the square root of their distances from the windward shore.*

TIDES, BED AND COASTS OF THE NORTH SEA.

MR. JOHN MURRAY, in a paper on this inquiry, commences by remarking that great similarity of outline pervades the western shores of Ireland, Scotland and Norway; he then observes that the great Atlantic flood-tide wave, having traversed the shores of the former countries, strikes with great fury the Norwegian coast between the Lafoden Isles and Stadland, one portion proceeding to the north; while the other is deflected to the south, which last has scooped out along the coast, as far as the sleeve at the mouth of the Baltic, a long channel from 100 to 200 fathoms in depth, almost close in shore, and varying from 50 to 100 miles in width. After describing his method of contouring and colouring the Admiralty chart of the North Sea, he traces the course of the tide-wave among the Orkney and Shetland Islands along the eastern shores of Scotland and England to the Straits of Dover, and along the western shores of Norway, Denmark and the Netherlands, to the same point. He then remarks that the detritus arising from the continued wasting away of nearly the whole line of the eastern coasts of Scotland and England, caused by the action of the flood-tide, is carried by it, and at the present day finds a resting-place in the North Sea; and that this filling process is increased by the sand, shingle, and other matter brought through the straits of Dover by the other branch of the Atlantic flood-tide. Hence, he remarks, the gradual shoaling of this sea, and the formation of its numerous sand-banks; the silting up the mouths of the Rhine, the Meuse, and the Scheldt; the formation of the numerous islands on the coast of Holland, that country itself, and much of Belgium; the deposits at the mouth of the Baltic, the islands in the Cattegat, and indeed the whole country of Sleswig, Denmark and Jutland.

The author then takes a view of the tides, and their effects upon the Baltic and its shores before the course of the tide-wave was checked by these shoals and low lands. He considers that, previous to these great changes, the flood-tide entering the North Sea between

Norway and Scotland, would make directly towards the German coast, and necessarily heap up the waters in the Baltic considerably above their present level; and that a great part of Finland, Russia, and Prussia bordering upon that sea, would thus every twelve hours be under water, in the same way as the waters now rise in the Bay of Fundy, at Chepstow, and other places, much above their ordinary level in the open sea; that the current outward, on the receding of the tide which these accumulated waters would occasion, combined with the rivers which fall into the Baltic, when checked by the following flood-tide, would cause deposits in the form of a bar tailing towards Sweden; and that an increase to these deposits would form shoals, drifts and islands, and eventually a long sandbank in outline, like the country of Denmark. He further considers that the tide being by these means prevented from entering the Baltic, may account for the subsidence of the waters of the Gulf of Bothnia better than can the upheaval of the northern part of Scandinavia.

The author then remarks that the great shoal of the North Sea is the Dogger Bank, and that its peculiar form is produced by the meeting of the cotidal waves, of which he traces the course. After bearing testimony to the value of the Admiralty chart of the southern portion of the North Sea, made under the direction of the late Captain Hewitt, he reverts to the importance of contouring such maps, in order to obtain something like a correct notion of the bottom of the sea; and in conclusion expresses a hope that the Admiralty will be induced to continue the survey of the North Sea, so well begun by Captain Hewitt.—*Proceedings of the Royal Society.*

THE ASTEROIDS.

MR. JAMES NASMYTH has communicated to the British Association a theory of the "Probable Origin of the Asteroids." He compares the planet whose scattered fragments are supposed to form the asteroids, to a Saint Rupert's drop. It had been in a state of fusion, the surface cooled, hardened, and resisted for a time the tension created by the contraction of the central portions. This tension became at length so strong that the crust yielded, and the mass became scattered, as in the case of the drop.

NEBULÆ EXAMINED WITH THE GREAT ROSSE TELESCOPE.

DR. ROBINSON has exhibited to the British Association, several drawings which contain careful delineations of several Nebulæ not previously examined; and the contemplation of which is well fitted to increase the obligations of the astronomical world to Lord Rosse, as well as to fill every mind with astonishment at the wondrous revelations of his matchless telescope. Each of them is a new proof of a former statement of his,—that this instrument would probably disclose forms of stellar arrangement, indicating modes of dynamic action never before contemplated in celestial mechanics.

"Dr. Robinson referred to the drawings of M. 51, in which the spiral or vorticose *arrangement of the stars* and unresolved nebulæ was first remarked in its simplest

form; and to others already published where it presents itself under conditions of greater complexity. He also referred to the important fact that the class of planetary nebulæ might now be fairly assumed to have no existence, as all of them which have been examined prove to be either annular or of a spiral character. Thus M. 97, which was considered by Sir John Herschel the finest specimen of them, and seemed even in his eighteen-inch reflector a uniform disc, presents in the six-feet a most intricate group of spiral ones, disposed round two starry centres, looking like the visage of a monkey. Among the new ones are H. 2241. It is a ring of stars, with faint nebula within, and a fine double star near its edges; H. 2075 of the same kind, but with a bright star almost exactly central, and nine others round it, evidently part of the same group. H. 450 is a most extraordinary object; the ring exactly circular, its light mottled and flickering, and within it what is evidently a globular cluster. Scarcely less surprising, but more magnificent from its association, is the planetary nebula at the edge of M. 46, which he had seen, though in a night not so favourable as that must have been when the drawing was made. It is a resolvable double ring, or rather spiral, with a central star; and from the improbability of two objects so rare as a splendid cluster, and one of their compound rings being *casually* connected, it seems reasonable to think they constitute one system. The double star ι Orionis belongs also to this class; and he called attention to the absolute darkness of the aperture in the nebula round the two stars, and that the larger of them was at its edge, instead of being central.

"He argued from the remarkable difference between these objects as seen in the telescopes of Lord Rosse (even the three-feet) and those of previous observers, how desirable it was that a complete review of the nebulæ should be made without loss of time. Even now much labour and talent were expended in theorizing on the imperfect data given by instruments which, though matchless in their time, have now been surpassed. Among others, he directed the notice of the Section to H. 602, where the two clusters and the associated spirals are propelled into ellipses; to H. 2205, in which the long, resolved ray, being the most intense, was alone seen by Herschel, but the magnificent spirals and their central stars escaped him. M. 65, and H. 857 appear to be helices seen obliquely. But the most curious one is M. 33, of which the centre is a triple star disposed as an equilateral triangle among a mass of smaller stars, from which proceed eight or nine spirals, and around all is an enormous nebula, in which however no spiral character had yet been traced. There were several examples of another singular system—nebulæ streaked with dark bands; such Bond discovered in the great nebula of Andromeda, H. 399, a wisp; H. 1393, a long ray of most marvellous appearance; H. 218, an oblique, with sixteen or seventeen dark transverse stripes; and H. 315, having in the nebula a cluster nearly insulated by offsets from the broad, curved, dark band,—are among the most surprising. But the number of these curious objects was so great that their time would only permit him to invite their notice to H. 1052 and 1053, where the cause of spirality had been interrupted by some other forces that bent the system at a right angle and drew the nebula into a straight ray; to H. 444, a double resolved nebula inclosed in a large and faint oval ring; and above all to M. 27, the "Dumb-bell" nebula as shown by the six-feet, with its brilliant two clusters of comparatively large stars, its dark bands, and the faint rings which surround it, differing even more from the picture of the three-feet than that does from the figure of Herschel. In the name of the Section he thanked Lord Rosse, not merely for the pleasure which they received from the sight of the wonders, but from the unremitted and precious gifts which he was conferring on astronomy. Would he also increase their gratitude by mentioning any improvements which he might have lately made in the methods of suspending these large specula in their tubes, or in the process of polishing the latter, with reference to the possibility of its being practised with success by persons who had not the long experience and mechanical knowledge of his lordship.

"Lord Rosse adverted to the peculiar condition of equilibrium which must prevail in these systems, or rather to the forces which are required to produce the peculiar constitution which they indicate, and pointed out the difficulties of such an investigation. It could, however, not be undertaken with advantage till we possess a much more extended collection of data,—to which he would contribute to the utmost of his power. These drawings were based on measures carefully taken with a bar-micrometer (the only one available in such cases), and

he believed they might be trusted. He had already described the improvement effected by supporting the speculum on its levers by 81 balls, and mentioned the striking fact, that with a speculum weighing 3½ tons, a slight pressure of the hand would deform for a time the image of a star. He had since effected a further improvement by supporting the edge of the speculum in a hoop mounted in jinmals. As to polishing, he had recently made many experiments with three-feet specula, in reference to the object of Dr. Robinson's question; and in particular had found that, by increasing the speed of the second excentric in this machine, the process was rendered so much more certain that, desiring one of his workmen, a smith, to perform the whole process, *without any superintendence* on his part, he produced a speculum,—not perhaps absolutely perfect, but capable of doing excellent work. He had no doubt that any person of ordinary mechanical capacity would be able to do as much with a little instruction; and he would be most willing to give that instruction to any observer that might be placed in charge of a large reflector."—*Athenæum*, No. 1299.

RAPID EVAPORATION OF SNOW AND ICE.

THE Rapid Evaporation of Snow and Ice in the winter and spring, long before the action of the sun has produced the slightest thaw or appearance of moisture, is made evident to residents in the high latitudes by many facts of daily occurrence; and the drying of linen furnishes a familiar one. When a shirt, after being washed, is exposed in the open air to a temperature of 40° or 50° below zero, it is instantly rigidly frozen, and may be broken if violently bent. If agitated when in this condition by a strong wind, it makes a rustling noise like theatrical thunder. In an hour or two, however, or nearly as quickly as it would do if exposed to the sun in the moist climate of England, it dries and becomes limber.

Mr. Rae mentions another example of the same fact, which bears on the transportation of boulders, and may interest geologists. During his memorable residence on the shores of Repulse Bay, he noticed several large boulders which were partially exposed at low water. When the sea froze they became engorged in the ice, and were lifted with it from the bottom by the flood-tides. The ice gaining at each tide in thickness beneath and losing above by superficial evaporation, the boulders in process of time came to rest in pits on its surface.—*Journal of a Boat Voyage through Rupert's Land and the Arctic Sea. By Sir John Richardson.*

DRYNESS OF ARCTIC AIR.

IN consequence of the extreme Dryness of the Atmosphere in winter, most articles of English manufacture made of wood, horn, or ivory, brought to Rupert's Land, are shrivelled, bent, and broken. The handles of razors and knives, combs, ivory scales, and various other articles kept in the warm rooms, are damaged in this way. The human body also becomes visibly electric from the dryness of the skin. One cold night, Sir John Richardson rose from his bed, and, having lighted a lantern was going out to observe the thermometer, with no other clothing than his flannel night-dress, when, on approaching his hand to the iron latch of the door, a distinct spark was elicited. Friction of the skin at almost all times in winter produced the electric odour.

KEW OBSERVATORY.

THE Report of the Council of the British Association, read at the meeting at Belfast, in September, 1852, shows

"That Mr. Ronalds's adaptation of photography to record the magnetic variations is an effective and practically useful invention, supplying to those who may desire it the means of making and preserving a continuous registry of the phenomena. The processes employed for the construction and verification of standard thermometers have proved remarkably successful, and will form the subject of a distinct and detailed Report from the Committee of the Kew Observatory. The thermometers prepared by Mr. Welsh, under the direction of the Committee, have been found on intercomparison, and also on comparison with Mr. Regnault's standard, to furnish results highly satisfactory. They have already been supplied on application to the observatories at the Cape of Good Hope and Toronto, and to several persons under the following regulation of the Council —'That standard thermometers made at Kew be supplied on application to members of the British Association and Fellows of the Royal Society at 1*l*. each.' The Council have also directed that the Kew Committee be authorized, at their discretion, to supply standard thermometers on official application to any department of Her Majesty's Government or to the East India Company; and, second, that the Committee be authorized, at their discretion, to present standard mercurial thermometers to certain of the philosophical instrument makers. In compliance with the first of these regulations, the Committee have supplied, on application from the Admiralty, fourteen thermometers graduated to extreme low temperatures, to be employed in the Arctic Expeditions; and, in compliance with the second regulation, they have presented standard thermometers to each of the following artists, viz.:—Messrs. Adie, Barrow, Newman, and Simms.

SCIENTIFIC BALLOON ASCENTS.

MR. JOHN WELSH has described to the British Association the general results of Observations during two Balloon Ascents, made under the superintendence of the Kew Committee of the Association, with the Nassau balloon, on August 17th and 26th. The subjects especially selected for examination were, first, the variation in the temperature and humidity of the air due to elevation above the earth's surface. Mr. Welsh then exhibited the instruments constructed for the occasion by Adie, of London, and which had been tested by comparison with the standards of the Kew Observatory. They consisted of a syphon-barometer, on Gay-Lussac's principle; two pairs of dry and wet thermometers; the dew-point hydrometers of Regnault and Daniell. One pair of dry and wet thermometers was mounted with the bulbs protected from the effects of radiation by double concentric shades, with brightly polished silver surfaces, open at top and bottom, for the free circulation of the air. The second pair had their bulbs enclosed within polished tubes, (also protected by polished shades), a brisk current of air being made to pass over them by the action of an aspirator. The object of this arrangement was, to diminish the effects of radiation,—to cause the thermometer to assume more readily the temperature of the surrounding air,—and to remove from the neighbourhood of the wet thermometer the vapour formed by evaporation from its bulb, and thus to cause the instrument to indicate with more accuracy the true temperature of evaporation. Care was taken to procure thermometers of extreme delicacy, the bulbs of those actually employed being cylindrical, about *half an inch long*, and one-twelfth of an inch in diameter;

they were found to assume the temperature of the surrounding medium with very great rapidity. The aspirator used was a pair of elongating cylindrical bellows which were drawn open by weights attached to their lower end—the air being allowed to enter by means of the tube which enclosed the dry and wet thermometer. The same aspirator was, by means of a second stop-cock and tube, used to produce the current of air necessary in operating with Regnault's hygrometer. About 100 observations were taken of the dry and wet bulb hygrometer during the first ascent, and about 160 during the ascent of the 26th. On the second occasion a considerable number of dew-point observations were obtained, which were generally confirmatory of the indications of the wet bulb hygrometer. On both occasions Mr. Welsh had been ably assisted in the observations by Mr. Nicklin:—the balloon being managed by Mr. Green. Specimens of air at great heights were brought down and supplied to Dr. Miller, of King's College, for analysis. The observations during both ascents had been partially reduced, and the resulting values of temperature and tension of vapour for different heights had been projected: these curves were exhibited to the Association. The principal features noticed in each were:—1st, that the tension of vapours decreased at a regular rate for some distances from the surface of the earth, and then *very abruptly* diminished by a large amount, being in fact reduced to nearly the lowest value attained during the remainder of the ascent. The height at which this sudden reduction in the quantity of aqueous vapour occurred was different on the two days—on the 17th it was about 5000 feet, and on the 26th nearly 8000.—2nd, it was also noticed that at the same elevation at which the great reduction of vapour took place, the gradual diminution of temperature was for some distance arrested—showing a relative *rise* in the temperature where the quantity of aqueous vapour *fell*. This fact was distinctly shown in both the ascents. On Aug. 17th, the greatest height attained was 19,500 feet: the lowest temperature was 8° Fah.; the temperature at the earth being 72°; the rate of decrease of temperature was 1° Fah. for 305 feet. On the 26th, the greatest height attained was 19,000 feet; the lowest temperature was again 8° Fah.; the temperature at the earth being 63°; and the rate of decrease of temperature 1° Fah. for 345 feet. On the 17th the greatest height was reached at 4h. 45m., P.M., and on the 26th at 7 P.M. Mr. Welsh concluded by acknowledging the admirable way in which Mr. Green managed his balloon, and the zeal and intelligence with which he went into the enterprises.

Sir David Brewster asked Mr. Welsh whether he experienced the oppression and difficulty of breathing which others had described as the result of such a rapid change of atmospheric pressure. Mr. Welsh replied that he had not felt the slightest inconvenience or difficulty; but that Mr. Nicklin had told him he had experienced a sense of fulness about the temples and slight headache. He also wished to add, that in his own case his assertion was only applicable to his state of feelings when he remained perfectly *still*; for he observed when at a high elevation he had occasion to

work the bellows of the aspirator, muscular exertion was accompanied by much greater fatigue than when under ordinary pressure.—*Athenæum*, No. 1299.

TREE STRUCK BY LIGHTNING.

THIS Tree stood in Clandeboye Park, in a thick mass of wood, and was not the tallest of the group. The lightning bolt struck it laterally about 15 feet above the ground, exactly at the cleft where the two principal branches of the tree rose from the trunk. A large part of the bark and a piece of the solid wood were driven to some distance; and the electric fluid passed down the trunk into the ground, splitting the tree in two by a rent through the whole of its thickness. The fact contained in this notice, that an object may be struck by lightning in a locality where there are numerous conducting points more elevated than itself, shows that a lightning bolt cannot be diverted from its course by conductors, and that the protection of buildings from this species of meteor can only be effected by conductors stretching out in all directions.—*Sir David Brewster; Proceedings of the British Association.*

HOW THE APPROACH OF AN EARTHQUAKE MAY BE KNOWN.

M. RATI-MENTON has communicated to the Paris Academy of Sciences, a paper stating an Earthquake indicator to consist of a magnet, to which is suspended by magnetic attraction a little fragment of iron. Shortly before the occurrence of an earthquake, the magnet temporarily loses its power, and hence the iron falls. According to M. Rati-Menton, the accuracy of this indicative sign has been thoroughly tested by an Argentine officer, Colonel Espinosa, during a residence of many years at Ariquipa—a region where earthquakes are very frequent.

INFLUENCE OF OIL ON WATER.

PROFESSOR HORSFORD, has read to the Albany meeting of the American Association, a paper, "On the Occurrence of Placid Water, in the midst of large areas, where Waves were constantly breaking." The Professor said he had noticed frequently that there were spaces of some extent, in places where the waves broke, which were very smooth; that though the swell, or rise and fall of the water, was just as great, yet there was no breaking of the waves, no white crest or comb; but he believed that these smooth spots were occasioned by oil, or oleaginous matter, which had accidentally happened to be spread on the surface at such places. To test this, he had, himself, when there was quite a stiff breeze, with waves on the surface of the water, which broke with considerable force off a comb or crest, emptied a phial of oil on the water from a boat. The effect was instantly seen. As far as the oil spread, the water was smooth, and the waves did not break; and what was very curious, the oil spread over the surface almost as rapidly to windward as it did to leeward. He had, therefore, inclined to the conclusion, that

the smooth spaces, which might be observed in the midst of places where waves broke, were owing to the presence of oil, which might either come from decaying fish, or some other substance from which oil exuded.

Commodore Wilkes confirmed the statement and observations made by Professor Horsford. He cited the instance where he had seen the same effects in a violent storm off the Cape of Good Hope, from the leakage of a whale ship. He stated it was very curious to observe over what a great extent a small quantity of oil would produce the effect spoken of.

THE BAKERIAN LECTURE.—THE PHYSIOLOGY OF VISION.

PROF. WHEATSTONE has delivered to the Royal Society, the Bakerian Lecture, "Contributions to the Physiology of Vision."—Part II. "On some remarkable, and hitherto unobserved, Phenomena of Binocular Vision." The first part of these researches was communicated to the Royal Society in 1838, and published in the *Philosophical Transactions* for that year. The second part commences with an account of some remarkable illusions which occur when the usual relations that subsist between the magnitude of the pictures on the retinæ and the degree of inclination of the optic axes are disturbed. Under the ordinary circumstances of vision, when an object changes its distance from the observer, the magnitude of the pictures on the retinæ increases at the same time that the inclination of the optic axes becomes greater, and *vice versâ,* and the perceived magnitude of the object remains the same. The author wished to ascertain what would take place by causing the optic axes to assume every degree of convergence while the magnitude of the pictures on the retinæ remains the same; and on the other hand, the phenomena which would be exhibited by maintaining the inclination of the optic axes constant while the magnitude of the pictures on the retinæ continually changes. To effect these purposes, he constructed a modification of his reflecting Stereoscope: in thisinstrument two similar pictures are placed, on moveable arms, each opposite its respective mirror; these arms move round a common centre in such a manner that, however they are placed, the reflected image of each picture in the mirrors remains constantly at the same distance from the eye by which it is viewed; the pictures are also capable of sliding along these arms, so that they may be simultaneously brought nearer to, or removed farther from the mirrors. When the pictures remain at the same distance and the arms are removed round their centre, the reflected images, while their distances from the eyes remain unchanged, are displaced, so that a different inclination of the optic axes is required to cause them to coincide. When the arms remain in the same positions and the pictures are brought simultaneously nearer the mirrors, the reflected images are not displaced, and they always coincide with the same convergence of the optic axes; but the magnitude of the pictures on the retinæ becomes greater as the pictures approach.

The experimental results afforded by this apparatus, so far as regards the perception of magnitude, are the following: the pictures being placed at such distances, and the arms moved to such positions, that the binocular image appears of its natural magnitude and at its proper distance, on the arms being moved so as to occasion the optic axes to converge less, the image appears larger, and on their being moved so as to cause the optic axes to converge more, the image appears less; thus, while the magnitude of the pictures on the retinæ remains constantly the same, the perceived magnitude of the object varies, through a very considerable range, with every degree of the convergence of the optic axes. The pictures and arms being again placed so that the magnitude and distance of the object appear the same as usual, and the arms being fixed so that the convergence of the optic axes does not change; while the pictures are brought nearer the mirrors, the perceived magnitude of the object increases, and it decreases when they are removed farther off; thus, while the inclination of the optic axes remains constant, the perceived magnitude of the object varies with every change in the magnitude of the pictures on the retinæ. After this the author takes into consideration the disturbances produced in our perception of distance under the same circumstances, and concludes that the facts thus experimentally ascertained regarding the perceptions of magnitude and distance, render necessary some modification in the prevalent theory regarding them.

The author next reverts to the Stereoscope and its effects. He recommends the origina lreflecting Stereoscope as the most efficient instrument, not only for investigating the phenomena of binocular vision, but also for exhibiting the greatest variety of stereoscopic effects as it admits of every required adjustment, and pictures of any size may be placed in it. A very portable form of this instrument is then described, and also a refracting Stereoscope suited for Daguerréotypes and small pictures not much exceeding the width between the eyes. In the latter instrument the pictures are placed side by side and viewed through two refracting prisms of small angle which displace the pictures laterally, that on the right side towards the left, and that on the left side towards the right, so that they appear to occupy the same place. When the first part of these investigations was published, the photographic art was unknown, and the illustrations of the Stereoscope were confined to outline and shaded perspective drawings; when, however, in the succeeding year, Talbot and Daguerre made their processes known, Mr. Wheatstone was enabled to obtain binocular Talbotypes and Daguerréotypes of statues, buildings, and even portraits of living persons, which, when presented in the stereoscope, no longer appeared as pictures, but as solid models of the objects from which they were taken. This application was first announced in 1841, The two projections of an object, seen by the two eyes, are different according to the distance at which it is viewed; they become less dissimilar as that distance is greater, and, consequently, as the convergence of the optic axes becomes less. To a *particular* distance belongs a specific dissimilarity

between the two pictures, and it is a point of interest to determine what would take place on viewing a pair of stereoscopic pictures with a different inclination of the optic axes than that for which they were intended.

The result of this inquiry is, that if a pair of very dissimilar pictures is seen when the optic axes are nearly parallel, the distances between the near and more remote points of the object appeared exaggerated; and if, on the other hand, a pair of pictures slightly dissimilar is seen when the optic axes converge very much, the appearance is that of a bas-relief. As no disagreeable or incongruous effect is obviously produced when two pictures, intended for a nearer convergence of the optic axes, are seen when the eyes are parallel or nearly so, we are able to avail ourselves of the means of augmenting the perceived magnitude of the binocular image mentioned at the commencement of this abstract. For this purpose the pictures, placed near the eyes, are caused to coincide when the optic axes are nearly parallel; and the diverging rays proceeding from the near pictures, are rendered parallel by lenses of short focal distance placed before the mirrors or prisms of the stereoscope.—Some additional observations were next brought forward respecting those stereoscopic phenomena which the author, in his first memoir, called "Conversions of Relief." They may be produced in three different ways:—1st, by transposing the picture from one to the other; 2ndly, by reflecting each picture separately, without transposition; and, 3rdly, by inverting the pictures to each eye separately. The converse figure differs from the normal figure in this circumstance, that those points which appear most distant in the latter are the nearest in the former, and *vice versâ*.—An account is then given of the construction and effects of an instrument for producing the conversion of the relief of any solid object to which it is directed. As this instrument conveys to the mind false perceptions of all external objects, the author calls it a Pseudoscope. It consists of two reflecting prisms, placed in a frame, with adjustments, so that, when applied to the eyes, each eye may separately see the reflected image of the projection which usually falls on that eye. This is not the case when the reflection of an object is seen in a mirror; for then, not only are the projections separately reflected, but they are also transposed from one eye to the other, and therefore the conversion of relief does not take place. The pseudoscope being directed to an object, and adjusted so that the object shall appear of its proper size and at its usual distance, the distances of all other objects are inverted; all nearer objects appear more distant, and all more distant objects nearer. The conversion of relief of an object consists in the transposition of the distances of the points which compose it. With the pseudoscope we have a glance, as it were, into another visible world, in which external objects and our internal perceptions have no longer their habitual relations with each other. Among the remarkable illusions it occasions, the following were mentioned:—The inside of a tea-cup appears a solid convex body; the effect is more striking if there are painted figures within the cup. A china

vase, ornamented with coloured flowers in relief, appears to be a vertical section of the interior of the vase, with painted hollow impressions of the flowers. A small terrestrial globe appears a concave hemisphere; when the globe is turned on its axis, the appearance and disappearance of different portions of the map on its concave surface have a very singular effect. A bust regarded in front becomes a deep hollow mask; when regarded *en profile*, the appearance is equally striking. A framed picture hung against a wall appears as if imbedded in a cavity made in the wall. An object placed before the wall of a room, appears behind the wall, and as if an aperture of the proper dimensions had been made to allow it to be seen; if the object be illuminated by a candle, its shadow appears as far before the object as it actually is behind it.—The communication concludes with a variety of details relating to the conditions on which these phenomena depend, and with a description of some other methods of producing the pseudoscopic appearances.

NEW ANALYSIS OF SOLAR LIGHT.

IN a series of papers* published by Sir David Brewster, he has endeavoured to establish a peculiar view which he entertains regarding the composition of Solar Light, and the generation of colours. These papers must naturally attract in a high degree the attention of physicians, both on account of the well-won renown of their author in the domain of optical science, and of the new facts which he adduces in support of his assertions. According to him, solar light is compounded of three different kinds of light, red, blue, and yellow; and each description of light possesses rays of all degrees of refrangibility, but so distributed that red light contains a preponderance of rays of less refrangibility, yellow more rays of mean refrangibility, and blue more of greater refrangibility; hence it is, that the first predominates at the less refrangible end of the spectrum, the second in the middle, and the third at the most refrangible end. The remaining colours of the spectrum, orange, green, violet, are supposed to be caused by the mixture of the three primitive colours. The prism can only separate those rays from each other which possess unequal degrees of refrangibility; if, however, there exist different kinds of light of the same refrangibility, the compound light formed by them must in the prismatic analysis behave as simple light. To this Brewster replies, that such rays may be separated from each other by taking advantage of their difference of absorption in coloured media; and he has attempted by means of this method to prove, that in all portions of the spectrum, rays of all three descriptions, and consequently the white light due to their union, is to be found. The facts which he calls in to support prove, he considers, that

* "Description of a Monochromatic Lamp, with Remarks on the Absorption of the Prismatic Rays," in Trans. of the Royal Soc. of Edinb. vol. ix. part 2. p. 433.—"On a New Analysis of Solar Light," Ibid. vol. xii. part 1. p. 123.—"Reply to the Astronomer Royal on the New Analysis of Solar Light," Phil. Mag. S. 3. vol. xxx. p. 153.—"Observations on the Analysis of the Spectrum by Absorption," *Ibid. vol. xxx.* p. 461.—"Remarks on the Elementary Colours of the Spectrum," *Ibid. vol. xxxii.* p. 489.

homogeneous light, in the sense of Newton, that is, light composed of rays of equal refrangibility (wave-length) only, sometimes suffers a change of colour in its passage through coloured media, while the universally accepted theory of Newton asserts that the colours of homogeneous light depends solely upon its refrangibility (wave-length); that such light may be weakened, nay, completely extinguished, in its passage through coloured media, but can never exhibit a change of colour. We must certainly grant that, if a single case be established in which the colour of homogeneous light is changed by absorption in a coloured medium, Newton's theory must be abandoned, and that of Brewster, or one similar, must be assumed in its stead.—M. H. Helmholtz, in Poggendorff's *Annalen*, 1852, No. 8, communicated by Dr. Tyndall to the *Philosophical Magazine*, No. 27, wherein M. Helmholtz mentions all the facts adduced by Brewster, and discusses those which we have been able to repeat, "abundantly proving," adds M. Helmholtz, "that in his method many hitherto unobserved influences come into play, which render a sure judgment of the colours impossible and deprive his arguments of all force. If the assumed connexion of the refrangibility or length of wave with colour is to be proved erroneous, it must be done by some more certain method of observation similar, for example, to that which I have described in this memoir; a principal condition of which is, that the colour investigated be separated from the other colours and rendered free from every trace of irregularly dispersed light."

OPTICAL PROPERTIES OF A RECENTLY DISCOVERED SALT OF QUININE.

PROF. STOKES has read to the British Association the following paper. This salt is described by Dr. Herepath in the *Philosophical Magazine*, No. 17, and is easily formed in the way there recommended:—namely, by dissolving disulphate of quinine in warm acetic acid, adding a few drops of a solution of iodine in alcohol, and allowing the liquid to cool; when the salt crystallizes in thin scales, reflecting (while immersed in the fluid) a green light with a metallic lustre. When taken out of the fluid the crystals are yellowish green by reflected light, with a metallic aspect. The following observations were made with small crystals formed in this manner:—The crystals possess in an eminent degree the property of polarizing light, so that Dr. Herepath proposed to employ them instead of tourmalines, for which they would form an admirable substitute, could they be obtained in sufficient size. They appear to belong to the prismatic system: at any rate, they are symmetrical (so far as relates to their optical properties and to the directions of their lateral faces) with respect to two rectangular planes perpendicular to the scales. These planes will here be called respectively the *principal plane of the length* and the *principal plane of the breadth*, the crystals being usually longest in the direction of the former plane. When the crystals are viewed by light directly transmitted, which is either polarized before incidence or analyzed after transmission, so as to retain only light polarized in one of the principal planes, it is found that

with respect to light polarized in the principal plane of the length the crystals are transparent and nearly colourless, at least when they are as thin as those which are usually formed by the method above mentioned. But with respect to light polarized in the principal plane of the breadth, the thicker crystals are perfectly black, the thinner ones only transmitting light, which is of a deep red colour. When the crystals are examined by light reflected at the smallest angle with which the observation is practicable, and the reflected light is analyzed, so as to retain,—first, light polarized in the principal plane of the length, and secondly, light polarized in the other principal plane,—it is found that in the first case the crystals have a vitreous lustre, and the reflected light is colourless, while in the second case the light is yellowish green, and the crystals have a metallic lustre. When the plane of incidence is the principal plane of the length, and the angle of incidence is increased from 0° to 90°, the part of the reflected pencil which is polarized in the plane of incidence undergoes no remarkable change, except perhaps that the lustre becomes somewhat metallic. When the part which is polarized in a plane perpendicular to the former is examined, it is found that the crystals have no angle of polarization, the reflected light never vanishing, but only changing its colour, passing from yellowish green, which it was at first, to a deep steel blue, which colour it assumes at a considerable angle of incidence. When the light reflected in the principal plane of the breadth is examined in a similar manner, the pencil which is polarized in the plane of incidence undergoes no remarkable change, continuing to have the appearance of being reflected from a metal, while the other or colourless pencil vanishes at a certain angle and afterwards reappears, so that in this plane the crystals have a polarizing angle. If then, for distinction's sake, we call the two pencils which the crystals, as belonging to a doubly refracting medium, transmit independently of each other, *ordinary* and *extraordinary*, the former being that which is transmitted with little loss, we may say, speaking approximatively, that the medium is transparent with respect to the ordinary ray, and opaque with respect to the extraordinary; while as regards reflexion, the crystals have the properties of a transparent medium or of a metal according as the refracted ray is the ordinary or the extraordinary. If common light merely be used, both refracted pencils are produced, and the corresponding reflected pencils are mixed together; but by analyzing the reflected light, by means of a Nicol's prism, the reflected pencils may be viewed separately, at least when the observations are confined to the principal planes. The crystals are no doubt biaxal, and the pencils here called ordinary and extraordinary are those which in the language of theory correspond to different sheets of the wave surface. The reflecting properties of the crystals may be embraced in one view, by regarding the medium as not only doubly refracting and doubly absorbing, but *doubly metallic*. The *metallicity*, so to speak, of the medium of course alters continuously with the point of the wave surface to which the pencil considered belongs, and doubtless is not mathematically null even for the ordi-

nary ray. If the reflection be really of a metallic nature, it ought to produce a relative change in the phases of vibration of light polarized in and perpendicularly to the plane of incidence. This conclusion the author has verified by means of the effect produced on the rings of calcareous spar. Since the crystals were too small for individual examination in this experiment, the observation was made with a mass of scales deposited on a flat black surface, and arranged at random as regards the azimuth of their principal planes. The direction of the change is the same as in the case of a metal, and accordingly the reverse of that which is observed in total internal reflexion. In the case of the extraordinary pencil the crystals are least opaque with respect to red light, and accordingly they are less metallic with respect to red light than to light of higher refrangibility. This is shown by the green colour of the reflected light when the crystals are immersed in fluid; so that the reflexion which they exhibit as a transparent medium is in a good measure destroyed. The author has examined the crystals for a change of refrangibility, and found that they do not exhibit it. Safflower red, which possesses metallic optical properties, does change the refrangibility of a portion of the incident light; but the yellowish green light which this substance reflects is really due to its metallicity, and not to the change of refrangibility, for the light emitted from the latter cause is red, besides which it is totally different in other respects from regularly reflected light. In conclusion, the author observed that the general fact of the reflexion of coloured polarized pencils had been discovered by Sir David Brewster in the case of chrysammate of potash;* and in a subsequent communication he had noticed in the case of other crystals the difference of effect depending upon the azimuth of the plane of incidence.† Accordingly, the object of the present communication was merely to point out the intimate connexion which exists (at least in the case of the salt of quinine) between the coloured reflexion, the double absorption, and the metallic properties of the medium.

Specimens of Sensitive Media were exhibited by Prof. Stokes. These were:—a crystal of green fluor spar, which, by the development of blue light within it, changed its colour;—the solution of the common bisulphate of quinine in acidulated water, which, by its action on the invisible rays developed blue light; and the solution of the green colouring matter of leaves in alcohol, which by a similar action became blood red.—*Athenæum*, No. 1300.

IMPROVED FORM OF REFLECTING INSTRUMENT FOR USE AT SEA, BY PROF. C. P. SMYTH.

THE peculiar circumstances of an observer at sea, caused chiefly by the rolling of the vessel, preclude the use of any of the ordinary instruments employed on land for measuring altitudes, depending, as they do, on levels or plumb-lines for their zero points. Recourse

* Report of the Meeting of the British Association at Southampton in 1846. Part II., p. 7.

† *Ditto Oxford, 1847.*

must be had to the principle of double images, by two reflectors, the method invented by Hadley and Newton. This one necessary principle has been carried out in a variety of different forms, in the sextant, quadrant, quintant, or a reflecting circle, some more or less accurate more or less convenient than others; but all of them, under whatever names they are known, are merely different forms of essentially the same instrument. Great ingenuity has been shown in many of their forms; but still the greatest degree of efficiency has not yet been arrived at, or the highest degree of convenience for all the various occasions required in practice. The ordinary form of the reflecting instrument at present in use is the sextant, in which will generally be found, even as made by the best makers, more or less of practical drawbacks—which the Professor enumerated—upon the speedy and accurate employment of it. The author then exhibited a reflecting instrument which he had had constructed by Messrs. Adie, of Edinburgh,—and which appeared to supply all the desiderata; for it was in the shape of a circle, small, light, and simple, with the delicate parts protected from injury under all circumstances,—the usual *loose* telescope and plain tubes were avoided by making them cross through each other and work on a pivot, thus admitting of instant alteration from one to the other, the illuminating apparatus was improved and rendered powerfully effective even with a faint light, and a small apparatus was added, which, without sensibly cumbering the instrument, gave, either by night or by day, a convenient horizontal referring point, visible in the field of view.

MODE OF REVIVING DORMANT IMPRESSIONS ON THE RETINA.

MR. GROVE has communicated to the *Philosophical Magazine*, No 20, the following experiment lately made by him on the revival of the images found on the retina by bright objects.

"1st. Look steadily at a luminous object sufficiently bright to be borne by the eyes without great inconvenience, then turn the eyes upon a dark body or dark space: an image of the object looked at will be seen, a fact familiar to every body. When the image has completely faded away and is no longer visible, pass backwards and forwards between the eye and the dark body a white substance, say a sheet of paper, the image will be immediately revived, and may be thus indefinitely reproduced.

"If the light is in the first instance not sufficiently vivid to produce the continued impression on the retina, but is nearly so, the invisible image may be brought out or first rendered visible by moving the white object between the eye and the dark body or dark space looked at. The white substance should be in a situation exposed to light so that its whiteness affects the eye, and not held in shadow. After a little practice, it is astonishing to what an extent and for how long a time images may be thus reproduced.

"2ndly. Reverse the experiment, looking from the bright object at white paper, and a dark image of the object will be seen; when this has faded away, move between the eye and the paper a dark substance held so as to reflect as little light as possible to the eye, and the image is reproduced on the white paper, or may be in the first instance produced as with the converse experiment.

"The explanation which occurs to Mr. Grove is, that the effect is one of contrast between the portions of the retina which have not been strongly affected and those which have.

"The white paper dulls or deadens the sensitive portion of the retina for an instant, more than the part which has been previously rendered non-sensitive to other impressions *than that which* it has received by the bright light, and the

black supervenes as a contrast to the parts affected by the white, but not to those unaffected. In the converse experiment, the black relieves or renders more sensitive the comparatively unaffected portions of the retina, but has little or no operation on the non-sensitive parts; thus at the moment of removing the black body, the unimpressed portions of the eye are affected by the white substance, but the impressed portion is comparatively dead to it. Probably coloured bodies looked at, and coloured screens moved to and fro, would give a series of complementary effects."

VISION UNDER WATER.

VISION under Water is attended with some curious consequences, the result of what is termed "internal" reflection. An eye placed under perfectly still water, as for instance, the eye of a diver, will see external objects only through a circular aperture (as it were) of 96° 55′ 20″ in diameter overhead. But all objects down to the horizon will be visible in this space; those near the horizon being much distorted and contracted in dimensions, especially in height. Beyond the limits of this circle will be seen the bottom of the water, and all subaqueous objects reflected and as vividly depicted as by direct vision; and, in addition, the circular space above mentioned will appear surrounded with a rainbow of faint but delicate colours. In the eyes of fishes, the humours being nearly of the refractive density of the medium in which they live, the action of bringing the rays to a focus on the retina is almost entirely performed by the crystalline lens, which is nearly spherical, and of small radius in comparison with the whole diameter of the eye; there is also a very great increase of density towards the centre, whereby spherical aberration is obviated, the corneal refraction having little influence.—*Todd's Cyclopædia.*

EXTRAORDINARY MIRAGE.

SIR DAVID BREWSTER has described to the British Association a remarkable case of Mirage in Radnorshire. Travellers in Switzerland observe not unfrequently their own shadows projected against the mists upon the mountains; but the peculiarity of the case described by Sir David, and what is extremely rare, is, that it is not a case of shadow but of reflection. A little girl saw her own image—her clothes with all their hues—painted against a cloud. She waved a victorine, and the image did the same, returning not only her motion, but also every colour, with the utmost fidelity. Sir David also gave an account of a singular case of vision, in which a person was able to see so small an extent of surface at once that a short distance he could only observe a feature at a time, being unable to take in the aggregation presented by the face. When the face was very distant, and thus its apparent magnitude sufficiently diminished, the whole of it was observed. In this case, as explained by Sir David, the retina was ineffective; the man saw with the choroid, which at one small place—the *foramen centrale*—is uncovered by the retina. The minuteness of this space permitted only a small amount of surface to be seen at a time.—*Literary Gazette,* No. 1861.

MOTIONS OF THE IRIS.

A PAPER on this inquiry, by Mr. E. B. Broadhurst, has been read to the Royal Society. The observations are distributed under three heads. First, the author examines the Iris in conjunction with the organic system of nerves. Secondly, he exposes the relation of the several nerves of the orbit in reference to the iris. And, thirdly, by tracing the membrane through the lower orders of animals, he shows the influence of the ophthalmic ganglion upon the iris, and the necessity of its presence for the accomplishment of the motions of the membrane, *i. e.* contraction and dilatation of the pupil.

The author's conclusions are: that contraction of the pupil is the active state of the iris, and that dilatation is its enervated condition; that a healthy retina and cerebral nervous arc are necessary to the motions of the iris, and the ophthalmic ganglion to motion; and that the primary motion of the iris is due to organic nervous influence, but its forced or animal motion to the reflected stimulus of light upon the retina.

PHENOMENA OF DIFFRACTION.

SIR DAVID BREWSTER has read to the British Association a paper, interesting chiefly as it afforded an explanation of certain screw-like fringes which had been observed when a Diffracting body, such as the point of a needle or a pin, was held in a beam of light, and the shadow projected on a screen, or examined with a telescope. Sir David asserted that these arose from the interference of the internal and of the external diffractive bands discovered by Newton. He pointed out the relation this explanation had to the curious fact, which had led him formerly to think that he had discovered a new property of light. This fact,—that certain fringes were seen when the edge of a retarding plate of mica was turned towards one end of the spectrum, which were not to be seen when it was turned towards the other end,—and which had given rise to so much discussion between himself, the Astronomer Royal, Mr. Stokes, and others,—he conceived to be thus fully explained.

MANIFOLD BINOCULAR CAMERA.

M. A. CLAUDET has exhibited to the British Association, a Double Camera, for taking the two stereoscopic Daguerréotypes of groups or individuals,—and by which four double pictures could be successively taken with such rapidity as to be exact representations of the same circumstances. It would be impossible to make all the mechanical arrangements of this instrument intelligible without drawings. The author also exhibited an instrument, which he called a stereoscopemeter; by which he could accurately measure the angles, by which could be determined the place of the group or figure to be taken, and the position in every one of their adjustments of the double camera and its slides.

NEW DRAWING INSTRUMENT.

MR. H. TWINING has described to the British Association an Instrument for obtaining correct Representations of Objects from Nature. This little instrument is on the principle of a theodolite; by which the angular positions of the several objects in a scene in nature which the artist had resolved to transfer to his canvas could be accurately recorded in his note-book, and afterwards at leisure by the aid of a square frame of crossing threads accurately placed in a picture of any determined size, according to certain simple rules, which the author pointed out.

FORMS OF IMAGES PRODUCED BY LENSES AND MIRRORS OF DIFFERENT SIZES.

SIR DAVID BREWSTER has read to the British Association a paper on this inquiry. The object was, to show that the photographic portraits taken with Cameras with large object-glasses or Large Mirrors must necessarily be distorted and hideous, as in fact it is notorious they are; and that hence all persons engaged in this new and most important art should receive with gratitude any scientific discovery which promised to correct so serious a defect—which by some has been attributed to the imperfection of the lenses employed,—by others to the unsteadiness of the sitter who is having his portrait taken,—by others again, to the constraint of features and limb under which he submits to the operation; but it is by all admitted and deplored. If we consider that the pupil of the human eye is only about 2-10ths of an inch in diameter, it is obvious that the images formed by the eye of those solid objects placed in front of it, and by which we are accustomed to see them, to judge of them, and to recognise them, cannot embrace any of the rays of light which come from those parts of the object which lie in such positions towards the sides, top, bottom or hinder parts as cannot pass in straight lines to an aperture of the size of the pupil,—in fact, unless it agree almost exactly with the exact perspective form of the object, the pupil being the point of sight. If then an object be placed before a lens, the part of the lens towards its centre of the size of the pupil is capable of forming a correct image of that object, consisting of rays coming from precisely the same parts of it as an eye would receive were its pupil in the same position. But all the parts of the lens or mirror of the same size which lie around and at a distance from this portion of it, would receive rays coming from parts of the solid object which the true eye could not receive, and which must therefore form as many unnatural images as there were such parts; and the photographic picture which embraces and confounds into one hideous mass all these, any one of which by itself would be correct, must in the very nature of things give a most confused and displeasing representation of the object.

Sir David illustrated and proved these assertions by a diagram of a lens with a simple solid form, a cylinder topped by a cone behind, placed in front of the lens, pointing out the parts which alone could be embraced in a correct perspective view of it, and what parts the

large lens or mirror would moreover receive and transmit rays from, to be jumbled in the photographic picture, with that which would alone give a correct idea of the object as seen. He showed from the now familiar illustration afforded by the binocular stereoscope, how very dissimilar were the pictures of the same object received by small lenses placed as near as the two pupils of the human eye; images so distinct that a child could readily distinguish them; and yet multitudes of such images were all received and jumbled together in those photographic pictures where lenses or mirrors of that or larger—say three or four inches—aperture were used. "The Photographer, therefore," said Sir David Brewster, "who has a genuine interest in the perfection of his art will, by accelerating the photographic processes with the aid of more sensitive materials, be able to make use of lenses of very small aperture, and thus place his art in a higher position than that which it has yet attained. The photographer, on the contrary, whose interests bribe him to forswear even the truths of science, will continue to deform the youth and beauty that may in ignorance repair to his studio, adding scowls and wrinkles to the noble forms of manhood, and giving to a fresh and vigorous age the aspects of departing or departed life." He then produced an exact diagram of photographic images of a simple object produced by Mr. Buckle, of Peterborough, whose Talbotypes obtained a Council Medal at the Great Exhibition. The acting diameter of the lens was $3\frac{1}{2}$ inches; and by using it with all covered, except a central space of 2·10ths of an inch diameter, and then along with this space exposing circular spaces of the same size towards the outer circumference of the aperture, the effect of the combination of the marginal pictures was most distinctly exhibited and demonstrated by haloes extending round the true image, and the sharp cross lines ruled on the object and shown in the image with the small lens, but all confused in that with the surrounding apertures.—*Athenæum*, No. 1298.

NINEVEH LENS AND GLASS.

Sir David Brewster has described to the British Association, an object of so incredible a nature that nothing short of the strongest evidence was necessary to render the statement at all probable:—it was no less than the finding in the treasure-house at Nineveh of a rock-crystal lens, where it had for centuries lain entombed in the ruins of that once magnificent city. It was found in company with several bronzes and other objects of value. He had examined the lens with the greatest care and taken its several measurements. It was not entirely circular in its aperture, being 1 6-10ths inches in its longer diameter and 1 4-10ths inches in its shorter. Its general form was that of a plano-concave lens, the plane side having been formed of one of the original faces of the six-sided crystal quartz, as he had ascertained by its action on polarized light,—this was badly polished and scratched. The convex face of the lens had not been ground in a dish-shaped *tool in the* manner in which lenses are now formed,

but was shaped on a lapidary's wheel, or in some such manner. Hence it was unequally thick, but its extreme thickness was 2-10ths of an inch, its focal length being 4½ inches. It had twelve remains of cavities which had originally contained liquids or condensed gases; but ten of those had been opened probably in the rough handling which it received in the act of being ground; most of them therefore had discharged their gaseous contents. Sir David concluded by assigning reasons why this could not be looked on as an ornament, but a true optical lens.

Sir David then exhibited specimens of the decomposed Glass found in the same ruins. The surface of this was covered with iridescent spots more brilliant in their colours than Peacock copper-ore. Sir David stated that he had several years since explained how this process of decomposition proceeded, on the occasion of having found a piece of decomposed glass at St. Leonard's. It had contained manganese, which had separated from the silex of the glass, at central spots round which circles of most minute crystals of true quartz had arranged themselves; bounded by irregular jagged circles of manganese, these being arranged in several concentric rings. When this process reached a certain depth in the glass it spread off laterally, driving the glass into very thin layers, and new centres seemed to form at certain distances, and thus the process extended.—*Ibid.*

THE THEORY OF COMPOUND COLOURS.

M. HELMHOLZ concludes a long investigation communicated to Müllen's *Archiv.*, and Poggendorff's *Annalen*, 1852, No. 9, with the following small table; it furnishes a general view of the combinations of every two colours, and in its construction five colours are assumed, by the union of which the colours of the spectrum are represented with sufficient accuracy. In the first horizontal and the first vertical series stand the simple colours; the compound colours which follow from their union are found at the intersection of the corresponding horizontal and vertical columns.

	Violet	Blue	Green	Yellow	Red
Red	Purple	Rose	Dull-Yellow	Orange	Red
Yellow	Rose	White	Yellow-Green	Yellow	
Green	Pale blue	Blue-green	Green		
Blue	Indigo	Blue			
Violet	Violet				

See the entire Paper communicated by Dr. Tyndall to the *Philosophical Magazine,* No. 28.

PHENOMENA OF VISION.

It has been ascertained beyond doubt, that in perceiving the tint of the scarlet geranium our eyes are affected by undulations recurring from four hundred and eighty-two millions of times in a second: that before we can appreciate the tint of the yellow blossom of the gorse or laburnum, five hundred and forty-two millions of millions of vibrations must have taken place; and that to discriminate the colour of the violet, not less than seven hundred and seven millions of millions of movements must have been communicated to the fibrilæ of our retina!—*Todd's Cyclopædia.*

MECHANICAL ACTION OF RADIANT HEAT AND LIGHT.

The deoxidation of carbon and hydrogen from carbonic acid and water, effected by the Action of Solar Light on the green parts of plants, is (as the author recently found was pointed out by Helmholz* in 1847) a mechanical effect of Radiant Heat. In virtue of this action combustible substances are produced by plants; and its mechanical value is to be estimated by determining the heat evolved by burning them, and multiplying by the mechanical equivalent of the thermal unit. Taking, from Liebig's Agricultural Chemistry, the estimate 2600 pounds of dry fir-wood for the annual produce of one Hessian acre, or 26,910 square feet of forest laud (which in mechanical value appears not to differ much from estimates given in the same treatise for produce of various kinds obtained from *cultivated* land), and assuming, as a very rough estimate, 4000 thermal units Centigrade as the heat of combustion of unity of mass of dry fir-wood, the author finds 550,000 foot-pounds (or the work of a horse-power, for 1000 seconds) as the mechanical value of the mean annual produce of a square foot of the land. Taking 50° 34′ (that of Giessen) as the latitude of the locality, the author estimates the mechanical value of the solar heat which, were none of it absorbed by the atmosphere, would fall annually on each square foot of the land, at 530,000,000 foot-pounds; and infers that probably a good deal more, 1-1000th of the solar heat, which actually falls on growing plants, is converted into mechanical effect.

. It is assumed in this communication to the Royal Society of Edinburgh, by Professor William Thomson) that the undulatory theory of radiant heat and light, according to which light is merely radiant heat, of which the vibrations are performed in periods between certain limits of duration, is true. "The chemical rays," beyond the violet end of the spectrum, consist of undulations of which the full vibrations are executed in periods shorter than those of the extreme visible violet light, or than about the eight hundred million millionth of a second. The periods of the vibrations of visible light lie between this limit, and another, about double as great, corresponding to the extreme visible red light. The vibrations of the obscure radiant heat beyond the red end are executed in longer periods than this; the longest which has yet been experimentally tested being about the eighty million millionth of a second.

When the vibrations of light thus act during the growth of plants,

* *Ueber die Erhaltung der Kraft*, von Dr. H. Helmholz. Berlin, 1847. A translation of this essay has appeared in the First Part of the New Series of the Scientific Memoirs, 1852.

to separate, against forces of chemical affinity, combustible materials from oxygen, they must lose *vis viva* to an extent equivalent to the statical mechanical effect thus produced; and therefore quantities of solar heat are actually put out of existence by the growth of plants, but an equivalent of statical mechanical effect is stored up in the organic products, and may be reproduced as heat, by burning them. All the heat of fires, obtained by burning wood grown from year to year, is in fact solar heat reproduced.

The actual convertibility of radiant heat into statical mechanical effect, by inanimate material agency, is considered in this paper as subject to Carnot's principle; and a possible connexion of this principle with the circumstances regarding the quality of the radiant heat (or the colour of the light), required to produce the growth of plants, is suggested.

NEW THERMOMETER OF CONTACT.

DR. TYNDALL has described to the British Association this new Instrument, which has very little in common with Fourier's thermometer of contact. It is applied to ascertain the velocity of the transmission of heat through either solids or liquids. The mass to be examined is reduced to the cubical form, and the instrument enables us to bring a source of heat of a strictly measurable character against one face of the cube, and to determine the relative quantity transmitted to the opposite face in a given time. By means of this instrument, which the Doctor minutely described, the author examined the conductivity of various bodies. The low conductive power of wood had already been established. Among crystalline bodies, rock crystal or fine silica is the best conductor. While wood, at the end of a minute, causes only a deflection of 10 or 12°, a cube of silica of the same size produces a deflection of 90°. This fact accounts for the steadiness of temperature in one-set districts, and the extremes of heat and cold presented by day and night on such sandy wastes as Sahara. The sand, which is for the most part silica, speedily drinks in the noonday heat, and loses it by night just as speedily. Muscular tissue is an extremely bad conductor; and to this, in a great measure, the constancy of temperature of the human body in various zones is to be attributed. To this fact also Sir Charles Blagden and Chantrey owed their safety in exposing their bodies to a high temperature; owing to the almost impervious character of the tissues of the body the irritation produced was confined to the surface.—*Athenæum*, No. 1300.

AIR RENDERED VISIBLE.

M. ANDRAUD has made a communication to the Paris Academy of Science, wherein he announces his discovery of the Visibility of the component parts of the Air, which he entitles "Æroscopie, or the molecules of air." Take a piece of card coloured black, pierce it with a fine needle, and look through the hole at the sky, on a fine day, or at a strong lamp, having a ground glass shade, when will be seen a number of transparent globes moving in the midst of confused

nebulosities. These little globes, some of which are more transparent than others, are molecules of air. Some of them are surrounded with a kind of halo. These latter, says M. Andraud, are the elements of azole. After continuing the observation for some time, we see small points detach themselves and disappear in falling; these, says M. Andraud, are atoms of carbon. This phenomenon of vision, it is essential to remark, passes within the eye itself: the molecules of air observed, are those which float in the liquid, which occupies the interior part of that organ.

The phenomena thus explained by M. Andraud, have been ably described by Mr. Hippisley, in a letter to the *Athenæum*, No. 1301, wherein he urges that the identity of *pattern* presented successively to the same eye by any number of these apertures, proves it to be something belonging to the structural condition of the eye itself which is thus seen, as probably, of its anterior membrane, of the crystalline lens, as of any other part; and that it is not impossible that some advantage might be derived in the investigation of some of the causes of indistinct sight from thus subjecting the eye to its own examination. In conclusion, Mr. Hippisley considers the visibility of the texture of the eye itself,—of the minute globules of the lachrymal fluid on its surface, possibly even of particles of dust slowly floating in the neighbourhood of the pupil (a condition of vision not unfrequently realized among philosophers) seen quite sufficient to account for the phenomenon of which so startling an explanation has been proposed.

Upon this communication Mr. R. W. Hardy, of Bath, has addressed the following letter to the *Athenæum*:

Permit me to supply an omission in the letter of Mr. J. Hippisley:—namely, that the appearances of the reticulated membrane of the cornea of the eye, and of the eyelashes, as seen in a small pin-hole made in cardboard and held before the eye, was a *re*-discovery, made by myself in August, 1851, and pointed out at that time by me to your Correspondent, while trying the Rev. R. W. Dawes's plan of using small apertures of the kind in question. The phenomena alluded to are not entirely new; they having been seen, though imperfectly understood, by Huygens, Leuwenhoek, and Gray about the middle of the seventeenth century; and subsequently by Sauvages, Plenck, Maskelyne, Dr. Adams, Good, and others. Gray describes the appearance as of "an *aerial concave speculum*," Sauvages as "*suffusio reticularis*," and Plenck as "*visus reticularis*." But none of the above, so far as I know, except Maskelyne, ever remarked a difference of pattern when looking at a luminous disc in a card (*i.e.*, a pin-hole) with different eyes.—These facts are pointed out in a paper drawn up by me, and presented to the Royal Astronomical Society in June last; and the preparatory notes for it were read by your Correspondent, Mr. Hippisley, early in the present year.

In the *Philosophical Magazine* for May, 1834, will be found a paper, by Sir David Brewster, we believe, entitled 'observations on the Visibility of the Retina,' which bears on the subject,—and should be consulted by those who are interested therein.

Electrical Science.

EXPERIMENTAL RESEARCHES IN ELECTRICITY BY MR. FARADAY.

THE *Twenty-eighth Series* of these researches—"On Lines of Magnetic Force; their definite character, and their distribution within a magnet, and through space," has been read to the Royal Society. For Series 24, 25, 26, and 27, see *Year-Book of Facts*, 1852, pp. 130—132. This and the *Twenty-ninth Series*, also communicated to the Royal Society, are the subjects of papers read by the author at the Royal Institution.

That beautiful system of power which is made manifest in the Magnet, and which appears to be chiefly developed in the two extremities, thence called ordinarily the magnetic poles, is usually rendered evident to us in the case of a particular magnet by the attractive or repulsive effect of these parts on the corresponding parts of another magnet; and these actions have been employed, to indicate both the direction in which the magnetic force is exerted, and also the amount of the force at different distances. Thus, if the attraction be referred to, it may be observed either upon another magnet or upon a piece of soft iron; and the law which results, for effects beyond a certain distance, is, that the force is inversely as the square of the distance. When the distance of the acting bodies from each other is small, then this law does not hold, either for the surface of the magnets or for any given point within them. Mr. Faraday proposes to employ a new method, founded upon a property of the magnetic forces different from that producing attraction or repulsion, for the purpose of ascertaining the direction, intensity, and amount of these forces, not to the displacement of the former method, but to be used in conjunction with it; and he thinks it may be highly influential in the further development of the nature of this power, inasmuch as the principle of action, though different, is not less magnetic than attraction and repulsion, not less strict, and the results not less definite. The term, line of magnetic force, is intended to express simply the direction of the force in any given place, and not any physical idea or notion of the manner in which the force may be there exerted; as by actions at a distance, or pulsations, or waves, or a current, or what not. A line of magnetic force may be defined to be that line which is described by a very small magnetic needle, when it is so moved in either direction correspondent to its length, that the needle is constantly a tangent to the line of motion; or, it is that line along which, if a transverse wire be moved in either direction, there is no tendency to the formation of an electric current in the wire, whilst if moved in any other direction there is such a tendency. The direction of these lines about and between ordinary magnets, is easily represented in a general manner by the well known *use of iron filings.*

The general conclusions are, that the magnetic lines of force may be easily recognised and taken account of by the moving wire, both as to direction and intensity, within metals, iron or magnets, as well as in the space around; and that the wire sums up the action of many lines in one result:—That the lines of forces well represent the nature, condition, direction, and amount of the magnetic forces: that the effect is directly as the number of lines of force intersected, whether the intersection be direct or oblique: that in a field of equal force, it is directly as the velocity; or as the length of the moving wire; or as the mass of the wire: that the external power of an unchangeable magnet is definite yet illimitable in extent; and that any section of all the lines of force is equal to any other section: that the lines of force within the magnet are equal to those without: and that they are continuous with those without, the lines of force being closed curves.—(See the paper, reported in the *Athenæum*, No. 1267.)

In the 29th Series, the lines are considered in the abstract. Without departing from or unsettling anything there said, in this paper the inquiry is entered upon of the possible and probable *physical existence* of such lines. We have not space for the details, which are reported in the *Athenæum*, No. 1290. In conclusion, Prof. Faraday observes: "All these facts, and many more, point to the existence of physical lines of force external to the magnets as well as within. They exist in curved as well as in straight lines; for if we conceive of an isolated straight bar magnet, or more especially of a round disc of steel magnetized regularly, so that its magnetic axis shall be in one diameter, it is evident that the polarities must be related to each other externally by curved lines of force; for no straight line can at the same time touch two points having northness and southness. Curved lines of force can, as Prof. Faraday thinks, only consist with physical lines of force. The phenomena exhibited by the moving wire confirm the same conclusion. As the wire moves across the lines of force a current of electricity passes or tends to pass through it, there being no such current before the wire is moved. The wire when quiescent has no such current, and when it moves it need not pass into places where the magnetic force is greater or less. It may travel in such a course that if a magnetic needle were carried through the same course it would be entirely unaffected magnetically, *i. e.*, it would be a matter of absolute indifference to the needle whether it were moving or still. Matters may be so arranged that the wire when still shall have the same diamagnetic force as the medium surrounding the magnet; and so in no way cause disturbance of the lines of force passing through both; and yet when the wire moves, a current of electricity shall be generated in it. The mere fact of motion cannot have produced this current: there must have been a state or condition around the magnet and sustained by it, within the range of which the wire was placed; and this state shows the physical constitution of the lines of magnetic force. What this state is, or upon what it depends cannot as yet be declared. It may depend upon the ether, as a ray of light does, and an association has already been shown between light and magnetism. It may de-

pend upon a state of tension, or a state of vibration, or perhaps some other state analogous to the electric current, to which the magnetic forces are so intimately related. Whether it of necessity requires matter for its sustentation will depend upon what is understood by the term *matter*. If that is to be confined to ponderable or gravitating substances, then matter is not essential to the physical lines of magnetic force any more than to a ray of light or heat; but if in the assumption of an ether we admit it to be a species of matter, then the lines of force may depend upon some function of it. Experimentally mere space is magnetic; but then the idea of such mere space must include that of the ether, when one is talking on that belief; or if hereafter any other conception of the state or condition of space rise up, it must be admitted into the view of that, which just now in relation to experiment is called mere space. On the other hand, it is, Prof. Faraday thinks, an ascertained fact, that ponderable matter is not essential to the existence of physical lines of magnetic force.

NEW VOLTAIC BATTERY.

MR. MARTYN ROBERTS has exhibited a Voltaic Battery of new construction, and professedly of great economy. It consists of fifty plates of tin, about 6 inches by 4,—each plate being adjusted between two plates of platinum of the same size. These are placed in stoneware cells about two feet deep, which were filled with diluted nitric acid. The object of these deep cells is to obtain a marketable product which shall be sufficiently valuable to cover the cost of the agents employed to effect the development of electricity. The upper stratum of nitric acid acts on the tin, and forms with that metal an oxide, which falls off from the plate the moment it is formed, and is precipitated as an hydrated oxide of tin to the bottom of the cell. This oxide is combined with soda, and as stannate of soda is extensively employed in dyeing and calico-printing, it is stated that this product will yield a profit of 20 per cent. on the cost of the battery by which it is produced. The electrical action of the fifty pairs of plates is considerable. The current is employed to exhibit the electrical light,—and the effects produced are certainly very brilliant. It was not possible to compare it with the result obtained from a Grove's battery, but we judge their powers to be nearly equal. An experiment made on the decomposition of water gave about 7 cubic inches of the mixed gases, oxygen and hydrogen, per minute. We cannot but regard this very ingenious arrangement as an improvement on the ordinary batteries, as far as economy is concerned, where an electric current is required, since the stannate formed must always be of considerable commercial value. It is curious, too, that the stratum of fluid in the immediate neighbourhood of the voltaic plates is kept uniformly of the same specific gravity, notwithstanding that the acid is rapidly removed. The oxide of tin formed takes down water with it, and at the same time establishes a current by which fresh acid is supplied to the plates. We were informed that the battery continued in most uniform action for sixteen hours.—*Athenæum, No. 1284.*

GRAPHITE BATTERIES.

At the late meeting of the British Association, Mr. C. V. Walker, after referring to the unfitness of copper, and the too great cost of the superior metals for the purpose of batteries, said he had early sought a substitute for both purposes, and had found one which seemed to promise all that was required in the deposit of carbon from gas, or Graphite.

VOLTAIC LEMON.

Mr. Le Molt has communicated to the *Lancet*, the means of constructing, for a few pence, this little voltaic apparatus, the external and internal portions of which already constitute three elements of the pile: it decomposes water, acts powerfully, but in a mediate manner, on the magnetic needle; precipitates metals, acts on the muscles and nerves of the eye, &c.; but its direct action upon the body is extremely weak. The Voltaic Lemon is constructed in accordance with theoretical laws: it contains in itself the *elements* of the pile, the *exciting acid solution*, and the *porous membrane* formed by the internal skin of the fruit. The duration of its action depends on the quantity of citric acid fluid contained in the lemon, which fluid, owing to its great abundance, will keep up the activity of the instrument for a long period. This apparatus offers 1000 times more advantage than the hydro-electric chain.

ARTIFICIAL MAGNET.

Mr. Walker has exhibited to the Ashmolean Society, at Oxford, an Artificial Magnet, manufactured by M. Elias of Haarlem. It is very powerful as to the amount it will lift, and is also remarkable for its power not being weakened by the sudden disruption of the keeper from the magnet, a quality not found in other magnets. M. Elias has obtained great celebrity by his magnets, in which the steel after being brought into the form of a bar, or horse-shoe, is passed through a coil of covered copper wire, one end of which is connected with the positive pole of a voltaic battery, and the other end to the negative pole when in action, thus making it an electro magnet by the current of electricity passing through the wire. The magnet is moved backwards and forwards within the coil, and the connexion must be broken when the centre of the magnet is in the coil. The magnet exhibited by Mr. Walker was composed of three horse-shoe magnets, forming a compound one; its weight was about 10lb. or 12lb., and it required 84lb. to separate the keeper from it.—*Mechanics' Magazine*, No. 1438.

NEW ARRANGEMENT OF THE VOLTAIC PILE.—BY M. FABRE DE LAGRANGE.

I have found a means of rendering the current of the voltaic pile perfectly constant and invariable, even for weeks or months, of whatever metals the electrodes may be formed; and whether they be set *in action by two liquids*, as in the combination of Bunsen, or by one,

as in that of Volta. This continuity of electric action is obtained in the same way that we obtain the continuity of the calorific action of a stove, which is furnished below with a grating to let the ashes fall, whilst we continually add fuel at the top.

First, a single pair with one liquid. Take a vessel with a hole in the centre of the bottom, such as a flower-pot, and round the hole let one end of a cylindrical diaphragm of cloth be attached by cement to the bottom of the pot. The axis of the hollow cloth cylinder when erect will coincide with the axis of the vessel, and its height is somewhat less than the walls of the latter. Within the diaphragm is placed a stick of very hard coke, such as is found in the gas-retorts, surrounded by small grains of the same coke ; and round the diaphragm a cylinder of amalgamated zinc and some acidulated water, furnished drop by drop from a reservoir above.

Next, unite the two poles by a conducting wire, and see what takes place in the interior of the apparatus. The acidulated water, which continues to drop into the vessel, will pass in part over the margin of the cloth diaphragm on to the grains of coke, which will thus be continually bathed by the movement of the liquid without being inundated, so that the polarization will be suspended and the bubbles of hydrogen will be freely disengaged through the interstices between the particles ; besides which, the lower strata of the acidulated water, in consequence of the pressure which they have to support, will filter slowly through the cloth, which will not be the case to any extent with the upper and middle strata. Now these lower strata are precisely those which contain the sulphate of zinc which it is necessary to eliminate. The result is an electric current, which is perfectly constant until the entire disappearance of the zinc, and which is obtained with no more care than that of keeping the reservoir filled.

My method of uniting a number of pairs is as follows :—The stoneware pots in which they are contained, which are three or four diameters in length, and consequently have the appearance of tubes, are united and cemented into a bundle or block, which is readily transported from place to place. The upper surface being horizontal, small gutters are employed to convey the acidulated water to each pot. With this arrangement, by placing a second reservoir above the pile, and altering the nature and elevation of the diaphragms, it is easy to employ a second liquid, which may be made to fall directly drop by drop on the grains of coke, such as nitric acid :—it may be used with advantage when very weak, and when it will no longer serve for the battery of Bunsen from its ceasing to absorb hydrogen. The liquids on leaving the pots are collected and may continue to be used until saturation.—*Comptes Rendus; Philosophical Magazine*, No. 22.

ELECTRIC CURRENTS OF THE FIRST AND HIGHER ORDERS.

WHEN an electric battery is discharged, the current which passes *through* the connecting wire is known to be capable of inducing a *secondary current* in another wire brought near it ; and if the *secondary current* be permitted to operate upon a third wire, a ter-

tiary current will be induced, which in its turn will induce a current of the fourth order in a fourth wire, and so on. The current which passes through the wire directly connected with the battery will in the following be called the *principal* or *primary current*. M. Riess has investigated these various currents, the circumstances under which they appear, their influence upon each other and upon themselves; and finally, attempts to clear the doubt which at present exists as to their directions.

Rejecting the method of inferring the strength of a current from its effect in the magnetization of a steel needle, the author makes the heating of a fine platinum wire, introduced into the circuit, and passing through an air thermometer of his own construction, the measure of the strength.

M. Reiss' paper, in Poggendorff's *Annalen*, (translated by Dr. Tyndall, in the *Philosophical Magazine*, No. 17,) presents at once an abstract of the whole of this important investigation, and establishes the fact, that not only does the primary current affect a second wire placed near it, but that the various portions of the said current affect each other; the strength of the current being thus proved to depend in some measure upon the shape of the wire through which it passes.

LAWS OF MAGNETISM AND DIAMAGNETISM.

PROF. MATTEUCCI, in a paper read to the British Association, has examined the influence of high temperatures and of compression on several substances. Iron, when passing from ordinary temperatures to a fusing heat, under the action of the oxyhydrogen blowpipe suspended by cocoon silk by a piece of caustic lime or a horizontal bar of copper wire in the magnetic field of a powerful electro-magnet, suffered a diminution, in one sufficiently exact experiment, of at least fifteen million times. All the compounds of iron and all natural substances containing a portion of metallic iron suffer a diminution by heat. Hence it is that all the natural and artificial compounds of magnetic and diamagnetic substances, such as certain coals and charcoal, impure metals, gold, copper, zinc, &c., which are attracted at ordinary temperatures, appear to be temporarily repelled when strongly heated. The repulsive action of diamagnetic substances suffers a very slight diminution by fusion. But this is not the case with bismuth, with respect to which the author has verified and completed the observation of Plücker. The Professor then detailed experiments proving this. He has also examined the influence of violent mechanical compression on magnetic and diamagnetic substances: for instance, by means of a copper box furnished with a screw, he compressed a cylinder of bismuth 3 millimètres diameter and 34 millimètres long to 28 millimètres, and found it had when compressed a diamagnetic action distinctly superior to that of its natural state. He has confirmed the fact discovered by Coulomb, and more recently by Plücker, that the *oscillation of bismuth* and of other feebly magnetic substances *is independent of their* weight,—or, in other words, that the diamag-

netic power is proportionate to the weight of the cylinder. He has also examined the influence of powerful electro-magnets on chemical affinity and on cohesion, and given several detailed results. He has studied the influence of the magnetic power of the elements on that of the body resulting from their combinations. Although some elements which are diamagnetic have magnetic compounds, such as the protochlorate of copper, he in general found that the magnetical character of the compound results from that of its elements. He has made a number of experiments on the laws of equilibrium of diamagnetic bodies in the magnetic field, and on the reciprocal action of diamagnetic bodies; the methods of observing used being simple and ingenious, chiefly by observing the change of form or the curve of the common surface of one fluid when floating on another. He passed over many other topics with brief notice; and concluded with calling Prof. Faraday's attention to what he believes to be the most important fact of these researches, and which relates to an experimental theory of diamagnetic phenomena. We abstain from publishing a full abstract, as the author wishes himself to arrange these researches before publication.—*Athenæum*, No. 1299.

MAGNO-CRYSTALLIC ACTION.

A PAPER has been read to the British Association, "On Poisson's Theoretic Anticipation of Magno-crystallic Action, by Dr. Tyndall. In an article in the *Phil. Mag.* for March, 1851, Prof. W. Thomson had drawn attention to the fact that Poisson had theoretically anticipated the discovery of magno-crystallic action by Plücker; and, in the latest number of the "Annual Report of Liebig and Kopp" Dr. Tyndall's investigations are referred to as especially corroborating the above view. Highly as he prized the support and coincidence of Prof. Thomson on a scientific subject, he must decline subscribing to his views in the present instance, and he thought he would prove that the theory of Poisson was unsuited to explain the phenomena of magno-crystallic action. By means of a powerful electro-magnet, Dr. Tyndall had been enabled to prove each of his statements by actual experiment. Poisson supposed a magnetic body to be an assemblage of magnetic molecules, and in the case of certain crystalline bodies, he imagined that these molecules possessed an ellipsoidal shape. Supposing such a body to be magnetized in a certain direction, and all these ellipsoids to lie with their longer axes in the same direction, the attraction of such a body parallel to these longer axes would be different from its attraction in a transverse direction. A differential action, such as that here indicated, was certainly established by the experiments of Prof. Faraday and Dr. Tyndall; but its cause is not to be referred to the shape of the molecules, as supposed by Poisson. A crystal of calcareous spar was hung in the magnetic field, and its action exhibited,—its optic axis set equatorial. A model of white wax of the same shape and size as the spar, and at first sight almost to be mistaken for a crystal, was hung in the magnetic field, and exhibited a precisely similar action—its axis also set *equatorial.* A crystal of carbonate of iron was next examined,—its

axis set from pole to pole; a magnetic model of the crystal did the same. Dr. Tyndall then proceeded to show that a bar of magnetic or of diamagnetic matter might be caused to set axal or equatorial, by simply varying its point of suspension. The experiments were closely watched by Prof. Thomson, who certified the success of every one of them. "Now," proceeded Dr. Tyndall, "we have here two substances, exactly alike in exterior shape,—the one a crystal built by nature, the other a model constructed by myself; you have seen that the actions of both are identical,—the one is not to be distinguished from the other. Whatever explains the deportment of the model must explain that of the crystal also. This piece of wax is composed of material particles; now I ask, what must the effect be if I squeeze this wax between two plates?—will it not be to bring the particles more closely together along the line on which the pressure is exerted? This is simply what has been done in the case of the model, and this peculiar arrangement of its particles (without reference to their *shape*) produces the effects which you have witnessed. Now, the action of the model comes under the head of magno-crystallic phenomena, and we see that the theory of Poisson is totally inadequate to its explanation. Magno-crystallic action is thus proved to be due, not to the shape of the ultimate molecules, but to their manner of arrangement."

Prof. Thomson said that he never meant to state that Poisson's physical theory was true,—indeed, he believed it to be erroneous. Dr. Tyndall's discoveries in this domain of science had cleared away a mass of rubbish, and set things in their true light. He had, himself, in many cases, repeated and varied Dr. Tyndall's experiments, and found them true.—*Ibid.*

ANIMAL ELECTRICITY.

M. Du Bois Reymond, of Berlin, has exhibited at the Royal Institution, before select parties of scientific men, some exceedingly curious and interesting experiments on Animal Electricity. His apparatus is of the most delicate construction, and although the electric currents have to pass through four miles of wire, the galvanometer needle is deflected in the most marked manner. An account of these experiments has been published by M. Du Bois Reymond in a work entitled 'Untersuchungen über Thierische Elektricität;' and we understand that Dr. Bence Jones has published an English translation of them.

We find an able review of Dr. Jones's Translation of M. Du Bois Reymond's work in the *Philosophical Magazine*, No. 24:—"The progress of discovery in this department of science is sketched, and the author afterwards passes on to describe his instruments and manner of experiment. We have a valuable and instructive chapter on the improved galvanometer. The helix of the larger instrument used by the author consists of the astonishing length of 3·17 English miles of copper wire in 24,160 coils! It would be difficult, if not impossible, without drawings, to give an intelligible description of the author's mode of experiment. Every precaution which experience

could suggest, and the most refined manual dexterity could apply, has been taken to secure accuracy, and rescue the results from incidental disturbances. The main feature in the experiments is, that the contact of metals with muscle or nerve, or with each other, is as much as possible avoided, connexion being established by cushions of bibulous paper moistened with a saturated solution of salt and water. Nor is contact with even these permitted, lest an irritating action should be exerted upon the tissue; the cushions are protected by a cover of pig's bladder with a little albumen spread over it, and upon or against this the tissue to be examined is laid."

NEW EFFECT PRODUCED ON MUSCLES BY THE ELECTRIC CURRENT.

M. DU BOIS REYMOND, in a paper read to the British Association, observes:—When a Current of Electricity is transmitted through any portion of a nerve, a current is excited, by a kind of induction, throughout the whole extent of the nerve. This peculiar action is described in the abstract of Du Bois Reymond's researches, recently translated into English by Dr. Bence Jones. A similar phenomenon with regard to muscles had long eluded the search of experimenters. It nevertheless exists, but with this difference:—When the exciting current ceases, the current aroused by it in the nerve ceases also; the current in the latter resembles the magnetism of soft iron, which is easily excited, but becomes null the moment the exciting cause ceases. Now a muscle stands in the same relation to a nerve that steel occupies with reference to soft iron; a current is also aroused in the muscle in the same manner as in the nerve, but a kind of coercive force is possessed by the former which confines the induced current within very narrow limits, and causes it to remain in action for some time after the original current has ceased.—*Literary Gazette*, No. 1860.

ELECTRICAL PHENOMENA.

M. BIOT has communicated to the Academy of Sciences, the following interesting account of some very curious Electrical Phenomena in Paris. The circumstances were brought before him by a young gentleman who was the subject of the phenomena, and in whose veracity he has the greatest confidence. "I was walking home," says the latter, "on the evening of the 17th of May, and was close to my house, when, at the corner of the Rue de Grenelle, an extremely loud thunder-clap, with an immediate prospect of heavy rain, made me quicken my steps. I had not advanced fifty paces, when a second thunder-clap, accompanied by lightning and rain, caused me to run. Instantaneously I perceived myself to be enveloped by so powerful a light that my eyes ached considerably, and at the same moment my hat was hurled from my head, although there was not a breath of wind. The pain in my eyes became so great that I was apprehensive of being struck blind; but the rain, which now fell in torrents on my head, recovered me very quickly from a state of bewilderment which may have lasted seven or eight seconds, and I perceived to my great joy that my eyesight was unim-

paired. I then hastened homewards, and soon reached my door. On going to bed I took out my watch, and I became then aware that the electric fluid had passed through the left pocket of my waistcoat. This pocket had a hole in the bottom sufficiently large to admit two fingers, and the edges of the hole evinced signs of having been burnt and frayed. The chain to which my watch was attached was not damaged, but the swivel was destroyed. A gold ring, confining several trinkets, was severed in five places, and the watch-key, which was made of steel plated with gold, was carried away, but the gold plating remained perfect. A small silver pocket compass had its poles inverted. As to my watch, it did not exhibit any outward signs whatever of injury, but instead of the hands pointing to 11h. 30m., as they should have done, they stood at 4h. 45m., and the works had stopped. Feeling persuaded that the main spring or some other part of the watch was broken, I put it down, intending to take it to the watch-maker the following day; but in the morning happening to wind it up, I found to my great surprise that the works were in order, and that the effect of the electric fluid upon them seemed to be limited to causing the main spring to run down. In the same pocket with my watch were a small medallion, in Berlin iron, circled with gold, and a little gold key. Both these articles had disappeared, having been doubtless carried through the hole in my waistcoat pocket. As for myself, I felt no other inconvenience than a stiffness in my spine, such as might result from severe physical labour; but neither my skin nor my clothes, with the exception of my waistcoat, showed any sign of the electric fluid. I must notice here a circumstance connected with my dress, which may have had considerable influence on the electric fluid. During my residence in Spain, I contracted the habit of wearing over my shirt, and under my waistcoat a sash of red silk wound five or six times round my waist. May not this silk sash have acted as an insulator? My money, which was in a purse in my trowsers' pocket on the same side as my watch, was untouched." M. Biot informed the Academy, with reference to this communication, that he had seen the waistcoat, and that of all the effects which had been occasioned by the electric fluid, he considered that which the watch had experienced as by far the most surprising. The compass and watch-key were submitted to the inspection of the Academy.—*Athenæum*, No. 1848.

HEATING FFECTS OF ELECTRICITY AND MAGNETISM.

MR. GROVE, in a paper on this inquiry, read at the Royal Institution, observes:—Assuming that the molecules of iron change their position *inter se* upon magnetization, then by repeated magnetization in opposite directions, something analogous to friction might be produced: and just as a piece of caoutchouc when elongated produces heat (as it was on this occasion experimentally shown to do), so a bar of soft iron might be expected, when subjected to rapid changes in its magnetic state, to exhibit thermic effects.

With the aid of the large magnet of the Institution and of a commutator for changing the direction of the electricity, a bar of soft

iron was alternately magnetized in opposite directions; and in a few minutes a thermometer placed in an aperture in the iron showed a rise of temperature of 1°·5 Fahrenheit; the bar being separated from the magnet by flannel, and the magnet being at a notably lower temperature than the bar, this heat could nowise be attributed to conduction.

ELECTRICAL PROPERTIES OF FLAME.

PROF. BUFF, of the University of Giessen, has communicated to the *Annalen der Chemie und Pharmacie*, a memoir with experiments, whence the following conclusions are drawn:—

1. Gaseous bodies which have been rendered conductible by strong heating are capable of exciting other conductors, solid as well as gaseous, electrically.

2. When a thermo-electric circuit is formed of air, hydrogen or carburetted hydrogen, alcohol vapour, charcoal, or finally a metal, whether combustible or incombustible, an electric current is developed, which proceeds from the hottest place of contact through the air to the less warm place.

3. The development of electricity which has been observed in processes of combustion, and particularly in flame, is due to thermo-electric excitation, and stands in no immediate connexion with the chemical process.

4. The products of combustion do not therefore by any means occupy the relation to the burning body which has been assumed by Pouillet; if positive electricity rises with the ascending gases, it is only in the degree in which the burning body and the air exterior to the place of combustion, or rather exterior to the place of hottest contact, are connected by a proper conductor.—See the paper entire, in the *Philosophical Magazine*, No. 16.

ELECTRO-CHEMICAL RESEARCHES ON THE PROPERTIES OF ELECTRIFIED BODIES. BY MM. FREMY AND BECQUEREL.

FOR several years the attention of chemists and physicists has been directed to the very remarkable modifications which certain bodies present when submitted to the action of a moderate temperature. We know that, under this influence, sulphur and phosphorus acquire new properties. The authors investigate whether electricity, like heat, can change the physical and chemical properties of different bodies. The experiments are then detailed, and the authors consider that they have shown, by rigorous experiments, that oxygen, under the influence of electricity, can become completely absorbable in the cold by iodine of potassium and several metals, such as mercury and silver.

These facts confirm the last researches of MM. Schönbein, Marignac and De la Rive, and show that electricity, in acting upon oxygen, developes properties in it which did not exist before its influence; we propose therefore simply to give the name of *electrified oxygen to the gas,* which. having been submitted to the action of *electricity, acquires* a particular state of chemical activity, and to

abandon the name of *ozone*, which expresses the idea of the transformation of the oxygen into a new body.—*Comptes Rendus; Philosophical Magazine*, No. 21.

ELECTRICITY APPLIED TO THE CAPTURE OF WHALES.

The *New Bedford* (U. S.) *Mercury* gives an account of some interesting experiments, illustrating the effect of Electricity to Facilitate the Capture of the Whale. The most prominent features of this new method are thus described:—"Every whale, at the moment of being struck by the harpoon, is rendered powerless, as by a stroke of lightning; and, therefore, his subsequent escape or loss, except by sinking, is wholly impracticable: and the process of lancing and securing him is entirely unattended with danger. The arduous labour involved in a long chase in the capture of a whale is superseded; and, consequently, the inconvenience and danger of the boats losing sight of or becoming separated from the ship is avoided. One or two boats only would be required to be lowered at a time, and therefore a less number both of officers and seamen than heretofore employed, would be ample for the purpose of the voyage. The electricity is conveyed to the body of the whale from an electro-galvanic battery contained in the boat, by means of a metallic wire attached to the harpoon, and so arranged as to reconduct the electric current from the whale through the sea to the machine. The machine itself is simple and compact in construction, enclosed in a strong chest weighing about 360 lbs., and occupying a space in the boat of about 3½ feet long, by 2 feet in width, and the same in height. It is capable of throwing into the body of the whale eight tremendous strokes of electricity in a second, or 950 strokes in a minute, paralysing in an instant the muscles of the whale, and depriving it of all power of motion, if not actually of life."

DR. KEMP'S NEW ELECTRO-MAGNETIC ENGINE.

In this invention, which is fully described in the *Repertory of Patents*, February, 1852, Electro-Magnetic Apparatus is so arranged that a series of electro-magnets are caused to act in succession by their armatures on the same bar or instrument, and by such bar or instrument is given motion to fluids in order to obtain and communicate power. To accomplish this object, the armatures of several electro-magnets are fixed to stems, and the stems of the armatures are to be free to move through the bar or instrument which carries them. For the purpose of enabling the armatures to be acted on in succession by their magnets, the stem of the armature which is to be first attracted is somewhat longer than the next in succession, by which means the first armature will be as near as may be to its magnet; and the next armatures being more and more distant from their electro-magnets, therefore when the first armature has been attracted by its electro-magnet, the others will be moved nearer to their electro-magnets, and will consequently be brought into the most advantageous position to be attracted thereby when their turns come.

In conclusion, a series of electro-magnets is caused to act in succession on a bar or instrument, in such manner that when combined with a comparatively large piston the power will, by driving or forcing the water or fluid with a cylinder of less diameter and of greater length, cause the piston therein to be moved with less power, but with greater speed. And it will at once be understood that the power obtained will depend on the effort each magnet is capable of exerting; for it will be evident that the actual force which is kept up to and given off from the piston in the small cylinder will be equivalent to that exerted by one of the magnets, in attracting or drawing its armature through a comparatively small space.

ELECTRO-MAGNETIC CLOCKS.

PROF. BRANDE has read to the Royal Institution, a paper "On Electro-Magnetic Clocks." Mr. Brande began by adverting to the various opinions which had been entertained in reference to the mutual relations of electricity and magnetism previous to the grand discovery of Oersted in 1819. As soon as the influence of an electrical current upon a magnetic needle had been developed by the researches of that philosopher, many important applications of the fact almost of necessity suggested themselves, amongst which the wonders of the electric telegraph were to be included. Another result of Oersted's discovery was the electro-magnet: the power, namely, of conferring by proper adjustments of an electric current any degree of magnetism upon a bar of soft iron: and inasmuch as these magnetic energies cease the moment that the electric current ceases, so we have it in our power to render any convenient form of soft iron, such as bars, or horse-shoes, powerful magnets at one moment, and at the next, entirely withdraw all their powers; and this, simply by making and breaking the contacts upon which the flow of electricity from voltaic arrangement depends. In this way a horse-shoe magnet was made alternately to lift and drop a weight, to raise and depress a loaded lever, and to bend and release a spring. These effects were merely due to the attractive force of the electro-magnet upon holders and bars of soft iron, with proper contrivances to prevent the interfering influence of the residuary magnetism which in such cases is more or less retained by the iron core of the coil. Another form of this application of electro-magnetism as a motive power consists in so arranging the electro-magnets that the poles may be alternately inverted, and so made to act upon adjacent permanent bar-magnets, both attractively and repulsively. These forms of the apparatus were exhibited.

Mr. Brande then referred to the excellent illustration which electro-magnetic clocks afford of the exclusive use of electro-magnetism as their moving power; its force being employed to give impulse to the pendulum, to propel the ordinary movement of the clock, and to effect the striking of the hour; no auxiliary weights or springs being in any case employed. From the pendulums, clocks, models, and diagrams, furnished for the occasion by Mr. Shepherd, Mr. Brande first explained the mechanism of the pendulum, which is so arranged

as to make and break an electric circuit, and consequently to make and unmake a horse-shoe magnet at each vibration. Each time that the magnet is made it attracts its armature, which lifts certain levers: one of these is concerned in raising a weighted lever and causing it to be held up by a latch or detent; the magnet is then unmade in consequence of the pendulum breaking the circuit, and the armature is released, when the pendulum lifts the latch, and allows the weighted lever to fall, which, in falling, strikes the pendulum so as to give it an adequate impulse: then the circuit is again completed, the armature attracted, the levers moved, the weight raised and held up by the detent; another vibration breaks the circuit and releases the armature; the pendulum then raises the detent, the weight falls, and in falling its arm strikes the pendulum, and gives it an impulse; and so on. But the pendulum at each vibration not only makes and breaks the electric circuit of the battery, which maintains its own action, but also, and simultaneously, that of a second battery, of which the duty is to make and unmake the electro-magnets belonging exclusively to the clock or clocks which are upon this circuit.

These electro-magnets act upon the extremes of one or more horizontal bar-magnets, so as alternately to attract and repel their opposed poles; and which carry upon their axis the pallets, by the alternating motion of which to the right and the left, the ratchet wheel is propelled onwards at the rate of a tooth each second, and the axis of this ratchet wheel carries the pinion which moves the other wheels of the clock. The circuit of the battery connected with the striking part of the clock is only completed once in an hour; and is connected with an electro-magnet so arranged as by means of a proper lever to pull the ratchet-wheel attached to the notched striking-wheel one tooth forward every two seconds, and each tooth is accompanied by a blow on the electro-magnetic bell. The number of blows depends upon the notched wheel, the spaces on the circumference of which are adapted to the number to be struck; and when this is complete, a lever falls into the notch, and in so doing cuts off the electric current, which is not re-established through the striking electro-magnet till the next hour, when a peg upon the hour wheel pushes the striking lever forward so as to cause it to be depressed by a similar peg upon the minute wheel. A very large working model of the clock and of the striking apparatus, constructed for the occasion by Mr. Shepherd, was exhibited, as well as a model of the pendulum and its appendages, made under the direction of Mr. C. V. Walter:—to whom Mr. Brande was also indebted for a signal bell, on the principle of Mr. Shepherd's clock bells, for the purpose of giving notice to the railway switchmen of the approach of trains in foggy weather.

Prof. Brande omitted all mention of Mr. Alexander Bain, the original patentee of the electric clocks, to whom was awarded the exhibition Council medal, class X.; and it is but justice to add that the first idea of working clocks by electricity is entirely due to Mr. Bain, who commenced putting it in practice in 1837. His first at-

tempt was to make a common clock transmit its time to other clocks at a distance, by the action of electro-magnets, in which he was perfectly successful. The next step was the application of the electric power to work single clocks, so that no winding might be required, and the common clock be dispensed with altogether. The ordinary galvanic apparatus was found, however, neither uniform nor lasting, giving more trouble and expense than the common clocks: and in prosecuting his experiments, Mr. Bain, in 1842, discovered that a plate of zinc, and one of copper, buried in the earth gave a uniform and continuous force of sufficient power to work clocks of any size, from the smallest mantel time-piece to large church clocks. In situations where it is inconvenient to obtain the electric current from the earth, the voltaic battery is resorted to; but in almost every case the first mode has proved the easiest, as well as the most effective. The cost of its plates is a trifle, and it has been ascertained that they will retain their efficacy for years. It is now shown to be possible that all the principal clocks in the kingdom might be united to keep time with one governing one, which, again derives its moving power from the earth, without winding up or need of attendance of any kind from one year's end to the other.

Mr. Bain has opened an establishment for the sale of his electric clocks, at 43, Old Bond Street; and has published *A Short History of Electric Clocks, with Explanations of their Principle and Mechanism, and Instructions for their Management and Regulation,* in which he undertakes to show that the electric clock is adapted for private houses, churches, and other places in which the ordinary wind-up clock is now used. His explanations are rendered clear and attractive by various diagrams.

"The character of Mr. Bain's clocks is now well known, and their value has been tested by the experience of several years. Many of the arrangements which are now introduced are novel, and well adapted to render electric clocks more generally useful than they have hitherto proved to be."—*Athenæum,* No. 1284.

THE UNDERGROUND AND SUSPENDED SYSTEM OF TELEGRAPH WIRES.

THE comparative advantages of the Underground System of Connecting Electric Telegraph Wires, as practised in Prussia, and the Suspended System in use in Great Britain, have been discussed by the Institution of Civil Engineers. On the first introduction of the electric telegraph, it was not known to what extent it would be employed; and on that account the suspension system was preferred, as enabling additional wires to be fixed with but little extra expense. At present, a single line of telegraph wire in Prussia, insulated by gutta percha covered with lead, laid at a depth of two feet under ground, costs 30*l.* per mile, inclusive of the instruments. The suspended system was shown to be not nearly so expensive, and when accidents occurred, they were more rapidly and easily repaired. The recent great improvements in Bain's printing telegraph were described, and it was shown, that by it three hundred words per minute had been sent through this instrument; that fifty-six thou-

sand messages per month had been transmitted on the Eastern Counties Railway, for railway purposes alone; and that such was its extended use for mercantile purposes, that the contents of a closely-printed 8vo volume was sent out in messages, per day, from the Central Telegraph Office alone. Such was the facility afforded by the instruments now in use, that they were chiefly worked by boys taken from the Orphan Asylum, who fully understood how to work them after a fortnight's practice. Several very ingenious applications of the instruments were described, and specimens of the submarine telegraph wire, intended to be laid down between Dover and Ostend, were exhibited. The general advantages of the introduction of the electric telegraph were pointed out, and it was stated that attention should be directed chiefly to improvements in the mode of insulation of the wires, in both the under-ground and the suspension systems, as the instruments were now comparatively perfect.

NEW MODE OF LAYING DOWN TELEGRAPH WIRES IN STREETS.

MR. CHARLES BRIGHT, manager of the British Electric Telegraph Company, has invented a mode of laying down the Wires in the Streets. The method adopted by the old Company has been to lay down a line of round cast metal pipes, through which the insulated wires are passed. This is necessarily a long and tedious operation, because considerable time is occupied, as each length of pipe is laid down, in passing the wires through it; but Mr. Bright's plan is to use pipes split longitudinally into halves. The under halves of the pipes are laid down in the trench; and then a large drum, on which the insulated wires are wrapped, is rolled along over the trench, and the wire is payed off easily and rapidly into its place—the upper parts of the pipes being put on afterwards, and secured in their places by means of screws through flanges left outside for the purpose. So well has this mode succeeded, that in Liverpool the whole lengths of the streets, from Tithebarn Railway Station to the British Telegraph Company's offices, in Exchange-street East, were laid down in a single night (11 hours); and in Manchester, the line of streets from the Salford Railway Station to Ducie-street, Exchange, in 22 hours. This was the whole time occupied in opening the trenches, laying down the telegraph wires, and relaying the pavement.

TELEGRAPHIC COMMUNICATIONS BY LAND AND SEA.

MR. F. C. BAKEWELL, in a paper read by him to the British Association, has taken a general review of the progress which has been made in this important medium for the transmission of intelligence, and examined the accidents which have still interrupted the perfection of the medium, with a view to suggesting remedies. Most of the facts stated by him have already had their record from time to time: but we may mention, that he exhibited a contrivance for still further facilitating Mr. Morse's plan for transmitting symbols, by making dots and strokes on chemically prepared paper;—and that in his *Copying* Telegraph—which, our readers will remem-

ber, he exhibited before this Section last year, and which has the great advantage of transmitting at once counterparts of the actual handwriting of parties, so that secrecy as well as the authenticity of the messages is secured—he has effected improvements which increase the rapidity of transmission to three hundred letters per minute.

TELEGRAPHIC TIME SIGNALS.

A PAPER has been read to the British Association, on Telegraphic Time Signals, by Mr. C. V. Walker. The object was, to explain the arrangements that have been completed, as far as his part in them extends, for promoting the scheme of transmitting Greenwich mean time throughout the kingdom. On the 5th of August the first time signal passed; and, on August 19th, the clock at Greenwich, which originates the signals, having been brought to time, and the adjustment elsewhere having been completed, the regular transmission of signals commenced—in the first instance, to Dover, at noon, and at 4 P.M. Mr. Walker then described the apparatus constructed by Mr. Shepherd, and erected at the London Terminus, by which the connexions are made. And, incidental to this, it is to be understood that in the galvanic-room at the Royal Observatory is a set of ordinary sand-acid batteries (to be replaced ultimately by graphite batteries); one battery termination is connected with the earth, by means of the gas-pipes,—and the other with a spring contained in Mr. Shepherd's electro-magnetic clock. The Greenwich London wire also terminates in the same clock:—and the connexions are such that, at the last second of the last minute of each hour, this line-wire and the battery-wire are placed in contact for an instant; consequently, if the circuit is completed at the other end of the wire, whether at London, Dover, Rochester, the Strand, Lothbury, or elsewhere, a signal will pass every hour; and, when the circuit is left open, no signal will pass. To accomplish this, a train of wheels is connected with the rod of Mr. Carter's large turret-clock, now erected over the South-Eastern Terminus. Sets of springs are placed near at hand to some of the wheels; the springs are all tipped with platinum, and are respectively connected with the several wires concerned in the scheme; and, according as the contacts between the several springs are varied, so is the time-signal led to its destination. Mr. Walker then explained an ingenious contrivance by which, at the completion of the circuit at Greenwich, a voltaic current of instantaneous duration passes from Greenwich to Dover, and causes one sharp deflexion of the galvanometer needle of the usual electric telegraph. The clerks at the several stations, should they overlook the general order to cease working, and to be on the watch, are reminded that the time is nearly due by finding that the telegraph circuit is broken; which happens during the two minutes that the spring is lifted by the pin off the earth wire at London. The clerks watch the signal, and make note of the error of their local clock. The time-signals, at set periods, are allowed to *pass automatically* to Hastings, to Deal, and to Ramsgate, by

turning them on the main line by the usual telegraph turn-plates now in use at junction stations. The signals are transmitted to intermediate stations by hand, which can be done correctly to a fraction of a second. The clerk watches for the signal while he holds in his hand the handle of a group, or a branch instrument; he moves his hand as he sees the signal, and a simultaneous signal passes along the group.

ELECTRIC TIME-BALL AND ILLUMINATED CLOCK.

THIS Time-ball, which has been placed upon the roof of the Electric Telegraph Company's office, No. 448, West Strand, and the Electric Clock in the roadway opposite, are thus described by Mr. E. Clark, engineer of the Company:—

"It has for several years been the practice of the Company to transmit daily to their more important stations in the provinces, as nearly as circumstances would permit, the true London time; but it was felt by the Electric Telegraph Company that, possessed as they were of means so extensive, it would be possible, as well as highly desirable, that an accuracy might be obtained which would prove extremely valuable to the principal towns and sea ports in the United Kingdom, and be available not only for ordinary domestic and commercial purposes, but also for the rating of Chronometers, and for all scientific investigations in which time forms an important element.

"During the summer of 1850, a sum of money was accordingly voted by the Electric Telegraph Company for these objects; and I, as their engineer, was instructed to take all necessary steps for carrying them out. An application was soon afterwards made to the Astronomer Royal for his valuable and indispensable co-operation in the undertaking, which, it is needless to add, was instantly and most cordially afforded. He had, indeed, long contemplated a telegraphic communication between the Greenwich and other observatories for astronomical purposes; and he proposed at once to make arrangements for giving the Company a daily signal from Greenwich. Wires were accordingly laid for Lewisham station on the South-Eastern Railway, and one of these wires was liberally appropriated for the Strand time signal; and was continued for that purpose through the streets by the Electric Telegraph Company to their office in the Strand. The permission of the South-Eastern Railway was necessary for this arrangement, and was granted without hesitation; and the work along their line was executed by their able and well-known telegraph engineer, Mr. C. V. Walker. The Ball at the Strand is liberated directly by a current sent from Greenwich through this wire. The ball, six feet in diameter, is made of zinc; and with its attached piston weighs about 2¼ cwt. When fully raised it is 129 feet above the level of the Thames; and it falls through a space of 10 feet. The rod which supports it passes down the centre of the column and carries at its base a piston, which, in its descent, plunges into a cast-iron air cylinder, ten inches in diameter, the escape of the air being regulated so as to check at pleasure the momentum of the ball, and prevent any concussion from its weight. The raising of the ball, half-mast high, takes place daily at 10 minutes to 1; at 5 minutes to 1 it is raised to its full height; and at one precisely, and simultaneously with the fall of the Greenwich ball, it is liberated by the current sent from the Observatory. The true moment of one o'clock is therefore indicated by the first appearance of the line of light between the dark cross over the ball and the body of the ball itself. Should anything interfere with the operation, the ball will be lowered half-mast high, where it will remain until five minutes to two; and will be liberated at two precisely by a second current from Greenwich, or will be slowly lowered to the base of the pole.

"The Illuminated Clock is moved by a voltaic current from a good regulator in the office, and is liable, therefore, only to the minute errors of this regulator during twenty-four hours, as by an apparatus attached to it it is daily set right by the fall of the ball. The minute-hand moves only at the termination of each minute, and the instant of its departure from any minute, indicates the com-

mencement of the next minute. It will thus be found to move over the last minute before one o'clock simultaneously with the fall of the ball. The Telegraph Company is indebted to Mr. Clark, the extensive lamp manufacturer in the Strand, for the willingness with which he gave up the prominent site selected. It is well known that the communication of time by means of voltaic currents originated with Mr. A. Bain, who has lent his valuable assistance in the details."

PROGRESS OF THE ELECTRIC TELEGRAPH SYSTEM IN 1852.

On Nov. 1, the operation of laying down the wires of the underground telegraph electric telegraph between Dover and the metropolis was completed; and a junction having been effected with the submarine cable, a direct communication was at once established between the offices of the "European and Submarine Printing Telegraph Company" in Cornhill and Paris. This new line of telegraph follows the route of the old Dover coach-road, passing through the several towns of Dartford, Gravesend, Rochester, Sittingbourne, and Canterbury, and has been laid down by Messrs. Frend and Hamill, of Bedford-row. Before the completion of this line all continental messages from London were conveyed by means of the South Eastern Railway Company's telegraph to Dover, where a break occurred, owing to the absence of direct telegraphic communication between the station and the office of the submarine company. It was partly to avoid this interruption, but mainly to save a very heavy rental paid to the South-Eastern Company for the privilege of using their telegraph, that the construction of the underground telegraph was resolved upon.

The line of telegraph of which we are speaking consists of six pure copper wires encased in gutta percha. These wires are manufactured in half mile lengths, which (after being joined together) are protected along the high roads by wooden troughs, and in towns by iron tubes, which are respectively sunk to an average depth of two feet beneath the surface of the ground. The troughs are of simple construction, being formed by sawing a deal into three, thus obtaining a square of about 2¾ inches, with a groove cut out at the planing mills, to contain the wires. The ends as well as the tops (which latter are about three-quarters of an inch in thickness), are cut to a bevel, and so the covering is made complete and secure. In the method of joining the iron tubes, the Company have availed themselves of a patent taken out by Mr. Brett, who is also (as is well known to our readers), the patentee of the process of telegraphic printing. This method resembles very nearly that plan of dovetailing which is commonly adopted in children's dissecting maps: viz. a circular dovetail on the casting of each alternate pipe is inserted into a corresponding aperture left for the purpose in the substance of the tube next adjoining it, and so on. The Company, foreseeing the possibility of injury to their wires, have provided at the end of each mile, a box, in which the continuous line of wire is coiled, for the length of some few yards; so that, should any mischance occur, the means of testing the soundness of the line, mile by mile, are at hand; for all that is requisite in such a contingency will be the severance of the coiled wire at the end of any given mile, and a trial of its efficacy up to that point by means of a portable battery.

Various messages were passed between Paris and London, somewhat interfered with by the dampness of the atmosphere on the French side, where the wires are not insulated. Amongst these was one to the President, wherein the Company said,—"May this wonderful invention serve, under the Empire, to promote the peace and prosperity of the world."—*Abridged from the Builder*, No. 509.

The engineers of the Company are Messrs. Wollaston and Crampton; to the latter of whom much is due for the successful initiation of the submarine telegraph.*

England and Ireland.—Of the three competitors, the Irish Electric Telegraph Company have completed this work; the cable being manufactured by Newall, Milnes, and Gordon, of Newcastle-on-Tyne, who supplied the Dover and Calais line. The Irish line was laid in eighteen hours; and in another hour the cable was ashore, the connexion completed with the land wires; and the indicators at the Dublin terminus of the Drogheda Railway, in Amiens-street, were conversing with those at the terminus of the Chester and Holyhead Railway, in Holyhead.

The principle on which their cable is constructed, differs from that hitherto adopted, and consists in insulating the interior wires by means of india-rubber as well as gutta percha. These, after being laid up or twisted into a rope, are passed through an anhydrous solution, and then covered with spun yarn, and formed into a hempen rope, which is again passed through another but different, anhydrous solution. The whole is then passed through a wire-rope machine, worked by steam, which encases the core in a metallic wire-rope, formed of twelve separate strands of six wires each, or seventy-two wires, in all forming a solid three-inch cable. These plaits or close convolutions of wire are thought preferable to the single spiral wire, as calculated to give greater flexibility and strength, and to prevent any portion of the cable from being unstranded. As it is manufactured it is payed off the machine, and formed into a flemish coil. The cable is 70 miles long, allowing 10 miles for contingencies, the distance from shore to shore being only 60 miles. There are four wires, making a total of 280 miles of copper wire. The double covering of the 70 miles of wire with gutta percha was executed by the Gutta Percha Company, at their works, in Wharf-road, City-road; it was then shipped to Gateshead, where the iron galvanized wires were added by Newall and Co.

The Shortest Channel Line.—A paper has been read to the British Association "On Telegraphic Communication between Great Britain and Ireland, by the Mull of Cantyre," by Mr. J. M. Rankine and Mr. J. Thomson. The advantages are as follows: it is the shortest line across the Channel, being only thirteen miles from Tor Point to the Mull of Cantyre; while the distance from Donaghadee to Portpatrick is twenty-two miles. It is the safest line; for no vessel can

* The completion of the Submarine Telegraph between England and France is detailed in the *Year-book of Facts*, 1852, pp. 145—148.

anchor across it. It has the local advantage of connecting the North of Ireland directly with the ports on the Clyde.

London.—The laying down of the new line of the Electric Wires from the branch office in the Strand, opposite Hungerford Market (where are also the Electric Time-ball and Clock, which correspond with the Royal Observatory at Greenwich), to the Telegraph-office at the General Post-office, St. Martin's-le-Grand, has been completed. This line runs along the kerb of the pavement on the northern side of the Strand, Fleet-street, Ludgate-hill, and St. Paul's Churchyard to Cheapside, thence crosses over to Foster-lane, and enters the branch office in the hall of the Post-office, whence the communication is kept up with the chief offices in Founders'-court, Lothbury, at the back of the Bank of England; whence messages are sent to, and received from, at all times, night and day, nearly every seaport town or place of any note throughout the United Kingdom of England, Wales, and Scotland (where there is the facility of a railway line); and, by the means of the Submarine Telegraph from Dover to Calais, to all parts of France and the continent, and also to Ireland. This is a new experiment; the electric wire being made of galvanized brass (instead of copper, coated with gutta percha, as in general use), and carried through iron tubes, which protect it not only from the inclemency of the weather, or other accidents which might occur in so great a traffic thoroughfare as from the Strand to the Post-office, but prevent it from atmospheric attraction, electric or otherwise.

In some experiments made by Mr. Reid, one instrument and battery being placed in the Admiralty, Whitehall, and the other in the Portsmouth Dockyard,—distance, in round numbers, one hundred miles,—several messages were sent to and fro from the Admiralty to the Dockyard by the miniature battery with perfect success. This battery being removed, the piece of silver and zinc was then introduced into the mouth of the operator, and a message sent from London to Portsmouth, and repeated back correctly.

The Continent.—The lines of Electric Telegraph completed in the Netherlands connect Amsterdam, Breda, Rotterdam, Haarlem, Dordrecht, and LaHaye, now for the first time, with Great Britain, by means of the submarine wires. The following cities and towns, with others of lesser note, are also in communication with the offices in Cornhill;—Agram, Aix-la-Chapelle, Amiens, Antwerp, Augsburg, Avignon, Baden, Berlin, Bonn, Bordeaux, Boulogne-sur-Mer, Bremen, Breslau, Bruges, Brunswick, Brussels, Calais, Cassel, Coblentz, Cologne, Cracow, Dantzic, Dieppe, Dijon, Dresden, Dunkirk, Dusseldorf, Florence, Frankfort-on Maine, Friburg, Ghent, Gotha, Hamburg, Hanover, Havre, Kehl Strasbourg, Konigsburg, Leghorn, Leipsic, Lemburg, Lisle, Lucca, Lyons, Metz, Magdeburg, Malines, Mannheim, Mantua, Marseilles, Mayence, Milan, Munich, Modena, Nantes, Nuremburg, Ostend, Padua, Paris, Pesth-Bude, Posen, Prague, Presburg, Parma, Rouen, St. Omer, Stettin, Stuttgard, Strasbourg, Trieste, Venice, Verona, Vienna, Weimar.

Piedmont.—A network of Telegraphic lines will soon be spread

over the whole kingdom, for the use of the public at large; and the best methods appear to have been adopted to combine economy in the construction, with efficiency in the service. But the line between Turin and Genoa, which has been already completed, has a peculiar feature. From Turin to Arquata the suspended wires follow the railroad; but from the latter place to Genoa, a chain of the Apennines intervenes, and there the real difficulties began. Mountains had to be bored, long tunnels constructed, deep ravines filled, and viaducts and bridges erected, before the railroad between Arquata and Genoa could be finished. Meanwhile, an immediate establishment of a telegraphic communication with Genoa being urgently wanted, the engineer Bouelli, Director of the Electric Telegraphs in Piedmont, adopted a bold and novel expedient by which he has successfully overcome all difficulties. He has thrown and suspended his wires from mountain to mountain at immense altitudes, and in straight lines, riding over deep ravines and valleys, without any intermediate supports, the poles being fixed on the summits at distances varying from 800 to 1,300 yards apart; occasionally, and when local circumstances require it, as in passing through villages and towns, the line is continued under ground, out of which emerging, and again meeting with high mountains, it resumes its flight, in the shape of a wire bridge from crest to crest; this again sinks under ground to travel below the streets of Genoa, till it reaches the station in the Ducal Palace. This picturesque line of telegraph is so well arranged, and the isolation of its wires is so perfect, that, notwithstanding the adverse circumstances presented by nature, it has been at work daily and nightly during the worst part of the winter, and has constantly been the ready and faithful messenger of the incessant movements of the operator's hand.

The French engineers had hitherto boasted of their successful adoption of long distances between the poles of suspended wires, and their *chef-d'œuvre* of the kind is the line between the *Passage Jouffroy*, in Paris, and the Palace of the Assembly, in which the greatest length of unsupported wire is 600 metres (equal to about 650 yards). But in the Sardinian line, the same principle has been successfully and repeatedly carried to double that extent, under much more unfavourable circumstances.

The engineer, Bouelli, is a gentleman, who, to high scientific attainments, unites a long practice of telegraphic engineering acquired in this country.—*Gazetta Piedmontese*, translated in the *Mechanics' Magazine*.

India.—Dr. O'Shaughnessy, of the East India Company's Medical Department, in constructing an experimental line for a distance of 80 miles from Calcutta, used the only materials at command, viz., a number of iron rods; these were fastened together, and supported on bamboos, and in this manner an *extempore*, but very effective, telegraph line was formed.

This enabled the Doctor to determine at once that the wires employed for the purpose in England would be quite inadequate to the

Indian telegraph. In England, where the lines are carried along railways, and where there are no living obstacles to contend with, the thin iron wire, called No 8 gauge, answers its purpose well; but no sooner were the rods mounted on their bamboo supports in India than flocks of that largest of all birds, the adjutant, found the rods convenient perches, and groups of monkeys congregated upon them; showing clearly enough that the ordinary wire would be insufficient to bear the strains to which the telegrapic lines would be subjected. It was found also that not only must the wire be stronger, but that it must be elevated higher, to allow loaded elephants, which march about regardless of roads or telegraphic lines, to pass underneath.

The instrument employed by Dr. O'Shaughnessy was a galvanometer made from the needle of a pocket compass, round which a coil of thin covered wire was twisted, and a strip of card was fixed on the needle to serve as an index. With instruments of this kind, which did not cost more than half-a-crown, signals were transmitted along the line with great ease at a rate of seven or eight words in a minute. The needle of this galvanometer, instead of being fixed vertically, as in the ordinary needle instruments, was laid horizontally in the magnetic meridian; and a permanent magnet was placed at one of the poles to cause the needle to return to zero quickly after each deflection. When the telegraphic communication had been thus practically effected, it was subjected to attacks to which the telegraphs in this country are but little exposed. Storms of lightning destroyed the galvanometer coils, and hurricanes laid prostrate the posts. Undaunted by the opposition of the elements, Dr. O'Shaughnessy contrived a lightning conductor for the instruments, and strengthened the supporting props.

Dr. O'Shaughnessy has since arrived in England, and at Warley, near Brentwood, has made arrangements for laying down 3000 miles of thick galvanised wire, to be shipped for India; one of the earliest lines undertaken, to be from Calcutta to Bombay. One of the peculiar characteristics of the railway lines intended for India, as contrasted with the English lines, is the greater distance between the posts, which are higher and stronger than those generally used. The thick wire is raised to a height of fourteen feet, on posts nearly the eighth part of a mile apart. To obtain the necessary strength to bear the strain, the posts are fixed with screw piles. To show the strength of the wires thus extended, a rope was, for experiment, hung to the centre of the wire of largest span, and a soldier climbed up it, the weight of his body producing but a slight curvature. The common deflection arising from the weight of a wire of a furlong span does not exceed eighteen inches. Dr. O'Shaughnessy's plan of underground communication, when such a mode of laying down the wires is desirable, is very economical. The copper wires coated with gutta percha, instead of being inserted in iron tubes, are inlaid in wooden sleepers, well saturated with arsenic, to protect them from the white ants, and they are then laid in a trench about two feet deep. An underground *system of two wires* may thus be laid down for £35 the mile. After

the mode of constructing the lines had been shown, Mr. Statham, the manufacturer of coated gutta percha wire, exhibited his plan of firing cannon with a gutta percha fusee. Ten thousand yards of coated wire were laid in coils on the common, and a cannon was three times fired through that length of wire by means of a voltaic battery, the flash of the powder being instantaneous with the contact of the wires.

The plan adopted for joining the lengths of the thick galvanized wire is to have the two ends turned, so as to link into one another, then introduced into a mould, like a bullet-mould, and an ingot of zinc being cast over them, they form a most substantial joint, and perfect metallic connexion.

United States.—In the *Journal of the Franklin Institute* for July, the total number of miles laid in the United States is stated to be:—

Morse Line	2,802	miles.
O'Reilly Line, using in most the of offices the modified Bain instrument—part of the O'Reilly Line using the Morse instrument	6,000	„
Morse Line (Old Line)	17,283	„
Bain Line	1,092	„
Total number of Miles in the United States	27,177	

Old and New Worlds.—The vast enterprise for connecting the Old and New Worlds by means of a magnetic wire has been commenced in America. The cable now laid down—and it is the first line sunk in the Transatlantic waters—forms the first section of the Newfoundland Electric Telegraphic Works. By its means, Cape Lormentine, in the province of New Brunswick, and Carlton Head, on Prince Edward's Island, are now joined in the electric bonds,—and the network of wires which extends on one side to the great lakes, and on the other touches the Gulf of Mexico, is advanced so many leagues nearer to the west of Ireland. The laying down of the sub-marine wires is said to have been quite successful.—*Athenæum*, Jan. 8, 1853.

This new proposed sub-marine line to connect the New World with the Old, is to commence at the most northwardly point of Scotland, run thence to the Orkney Islands, and thence, by short water lines, to the Shetland and the Ferroe Islands. From the latter, the water line of 200 to 300 miles conducts the telegraph lines to Iceland; from the western coast of Iceland another sub-marine line conveys it to Kioge Bay, on the eastern coast of Greenland; it then crosses Greenland to Juliana's Hope, on the western side of that continent, in latitude 60 deg. 42 min., and is conducted thence, by a water line of about 500 miles, across Davis's Straits to Byron's Bay, on the coast of Labradore. From this point the line is to be extended to Quebec. The entire length of the line is approximately estimated at 2,500 miles, and the sub-marine portions of it at 1,400 to 1,600 miles. The peculiar advantages of the line being divided into several sub-marine portions is, that if a fracture should at any time occur, the defective part could be very readily discovered, and repaired promptly and at comparatively trifling expense.

Chemical Science.

ENDOSMOSE OF LIQUIDS.

PROF. GRAHAM has communicated to the British Association some valuable notices of experiments on the Endosmose of Liquids. He described an instrument, termed an Osmometer, by which he measured the diffusion of solutions of salts through porous membranes into water, and he had arrived at several curious results, not the least among which was the almost entire abnegation of the action of exosmose. He classified solutions of salts, and other liquids, according to their diffusibility through membranes; among the most diffusible being the combinations of the alkalies with the vegetable acids—a curious fact, when we consider the presence of these salts in the sap of plants.

GREAT PRINCIPLES SUGGESTED OR WORKED OUT BY THE LATE DR. PROUT.

PROF. DAUBENY, in a paper read before the Ashmolean Society of Oxford, observes:—"Dr. Prout suggested an explanation of the differences existing between those organic bodies whose constituents had appeared identical, by the interference of infinitessimal portions of certain extraneous substances intermixed with their predominant ingredients; and started the idea, which Liebig has followed up with so much success,—that these latter may be of essential use, inasmuch as they render the body itself suitable to be assimilated by animals, owing to their counteracting in it those chemical affinities between its particles which would otherwise be too powerful for the antagonistic forces of life to surmount.

"Substances so constituted he called *merorganized*, and the introduction of these foreign matters he regarded as the cause of that new arrangement of their particles which imparted to them properties altogether distinct from those which before characterized them, Thus, starch he regarded as merorganized sugar, and considered the latter body to be incapable of assimilation, until it had undergone an alteration of this kind within the body.

"Dr. Prout also led the way towards the establishment of that beautiful classification of substances subservient to nutrition which Baron Liebig has lately brought so prominently forward, and made the foundation of so many striking and interesting speculations. His paper 'On the Ultimate Composition of Simple Alimentary Bodies' shows that they are divisible into three kinds, namely, the saccharine, the oily and the albuminous, and likewise that the milk which nature has provided for the support of the young in mammiferous animals is alone capable of sustaining life, because it contains all three.

"Thus, while the former inquiry of Dr. Prout's contains the germ *of one great principle* so insisted upon by Liebig: namely, the *necessity for those minute* quantities of mineral matters which are found

to be present in plants, the latter suggested the groundwork of the Baron's other great work, in which he has explained so luminously the nature of the proximate principles required for the nutrition, and for the maintenance of heat in animals. With regard to inquiries more purely medical, Dr. Prout first gave a clear idea of the constitution of the urine, and showed that the secretion of urea took place in the bloodvessels, whilst it was merely eliminated by the kidneys. By ascertaining that the urine of reptiles consists wholly of uric acid, he took the first step towards pointing out the relation between that body and urea, which latter Liebig supposes to be produced in warm-blooded animals, through the oxygenation of the former compound.

While the late Dr. Prout, by a luminous train of research, threw so much important light upon the physiology of calculus, and other urinary disorders, he advanced at the same time our knowledge of digestion itself, by his discovery that the stomach in a healthy state always contains free muriatic acid. Hence, probably, the necessity of salt for all the higher animals.—*Jameson's Journal,* No. 104.

NEW REMEDY FOR INDIGESTION.

THERE has been read to the Paris Academy of Sciences, a paper by M. Corvisart, proposing, as a remedy for weak digestion, the use of gastric juice taken from animals. M. Corvisart argues that Indigestion in the human stomach arises entirely from the want of a sufficient quantity of gastric juice, and that if the deficiency were supplied from the sources of which he speaks, the digestion would be perfect. As this gastric juice, in its natural state, is of a taste and appearance which would be repulsive to most patients, M. Corvisart has proposed that it shall be reduced to the state of powder, paste, &c., and mixed with the aliments.

PHYSICAL AND CHEMICAL CONSTITUTION OF NATURAL WATERS.

FROM the researches which M. E. Marchand has for a long period made upon the Physical and Chemical Constitution of Natural Waters, and their geological origin, he draws the following conclusions:—

1st. All natural waters, at least in the circumstances of which I shall presently speak, contain iodine and bromine.

2nd. All these waters contain lithia.

3rd. The whole of them, when they take their origin from superficial deposits connected with chalk, or in calcareous districts, contain iron.

4th. The origin of iodine and of bromine in water proceeds from the transportation of these principles from the water of the sea, from the vapours or the aqueous particles which incessantly escape from it, and which, transported to the continents, fall to the earth, in the state of rain, of snow, or of hail. The waters composing rain and snow generally contain an appreciable proportion of iodurets and of bromurets.

5th. In well-wooded countries, iodine and bromine may disappear from the water which holds them in solution, by passing to a saline state under the influence of vital forces, due to the number

of mineral principles engendered by vegetation. The ashes of the greater part of our forest-trees, elm, beech, fir, &c., contain iodine.

6th. The determinating causes of goitre and cretinism are not to be found in the existence of carbonate of magnesia in the waters which those afflicted with goitre and cretinism use for their necessary food.

7th. The determinating cause of these maladies exists rather in the absence of iodine and bromine from the number of constitutive principles of these waters.

8th. The physical and chemical constitution of water varies each day in the year, and, perhaps, even in every moment of the day. At the seasons when the temperature is highest, the density of the water is also strongest, and their richness in saline principles most considerable. A sudden variation in temperature produces also a considerable variation in the constitution of the water.

9th. We knew before this time the influence of the clearing of forests upon the abundance or scarcity of springs. We had never, however, reckoned upon the influence of vegetation in general, and, particularly, of the influence of cultivation of agricultural plants upon these same phenomena. It is generally believed that springs are more abundant in winter than in summer. This opinion is erroneous; it results, from my observations, that, in limestone formations at least, the springs are more abundant when vegetation is most active, and that they decrease in importance in proportion as vegetable life is extinguished. They are at their minimum of production about the 15th or 20th of January.

10th. All our water, of springs, of brooks, of rivers, contain azotes; and, nevertheless, the water of the sea which receives these different fluids does not contain appreciable traces of these salts. This may be accounted for, on the one hand, from the influence of the respiration of fishes; the azotes contained in water, in passing with it through their gills, undergoes a decomposition of which the result is ammoniacal. On the other hand, in the depth of the ocean, a considerable quantity of univalve and bivalve mollusca are found (oysters, mussels, &c.), which continually excrete a certain quantity of free sulphuretted hydrogen, which, in its nascent state, ought still to convert to the ammoniacal state the nitric acid of the azotes with which it is in contact. The mud and slime deposited by the waters contain crystals of ammoniaco-magnesian phosphates, and the waters contain hydrosulphuric acid.

11th. Hydrosulphuric acid, free or combined, is also often, if not always, found in rain water. It is this principle which supplies with sulphur the plants belonging to the cruciferous family.

12th. From this last fact, it results that those localities which are infected by hydrosulphuric acid, may be purified therefrom by the cultivation of plants belonging to this family.—*Jameson's Journal*, No. 105.

EXPANSION OF SOME SOLID BODIES BY HEAT.

M. Kopp, from a very laborious and valuable investigation, "*Taking every* possibility of error into account, considers that we

may infer with certainty from the preceding numbers, that the expansion of solid substances is by no means determined by their chemical nature. The difference between the coefficients of expansion for arragonite and calcareous spar is so great as to destroy all hope of establishing any relation of the kind. Neither does the expansion appear to depend altogether on the arrangement of the atoms; for although bitter spar and carbonate of iron agree, and heavy spar differs but little from cœlestine, in the cases of carbonate of iron and carbonate of lime, and of rutile and oxide of tin, no such agreement exists. The table further shows that there are many non-metallic substances which expand as much under the action of heat as the metals themselves."—*Philosophical Magazine*, No. 18.

ON A NEW MODE OF MEASURING HIGH TEMPERATURES.

BY MR. JOHN WILSON.

After referring to, and describing briefly the pyrometers at present in use, Mr. Wilson explains the method employed by the author to Measure High Temperatures. According to his plan, a given weight of platinum is exposed for a few minutes to the fire, the temperature of which is required to be measured, and then plunged into a vessel containing water of a determined weight and temperature. After the heat of the platinum has been communicated to the water, the temperature of the water is ascertained; and from this is estimated the temperature to which the platinum was subjected. Thus, if the piece of platinum employed be 1000 grains, and the water into which it is plunged be 2000 grains, and its temperature 60°, should the heated platinum when dropped into the water raise its temperature to 90°, then $90°—60°=30°$; which, multiplied by 2 (because the water is twice the weight of the platinum), gives 60°, that an equal weight of water would have been raised. Again; should the water in another case gain 40°, then $40°\times 2=80°$, the temperature measured by the pyrometer. To convert the degrees of this instrument into degrees of Fahrenheit, we must multiply by 31·25, or $31\frac{1}{4}$. Thus, $80°\times 31\frac{1}{4}$ would give 2500° of Fahrenheit. And $50°\times 31\frac{1}{4}=1875°$. The multiplier 31·25 is the number expressing the specific heat of water as compared with that of platinum, the latter being regarded as 1.

In order to attain very accurate results by this method, precautions similar to those required in determining the specific heat of bodies must be taken; that is, it is necessary to guard against the dissipation of heat by conduction and radiation. The apparatus used by the author consists of a polished tinned iron vessel, of a cylindrical form, 3 inches deep and 2 inches in diameter; this is placed within a concentric cylinder, separated from the enclosed vessel about $\frac{1}{4}$ inch. By this means there is but little heat lost during the experiment, either by radiation or conduction.—*Proceedings of the Institution of Mechanical Engineers, Birmingham.*

ARTIFICIAL FREEZING OF WATER IN BENGAL.

A Penhomenon resulting from the combination of the two frigorific *actions, successively* excited in the radiating body, and the medium

which envelopes it, is the congelation of water, produced artificially in Bengal, during the calm and clear nights. It would be superfluous to repeat here the details relative to this process, a description of which may be found in all treatises on physics. It will be sufficient to call to mind, that the vessels, very shallow and uncovered, containing the liquid to be frozen, are placed at the bottom of certain excavations made in the soil, and surrounded by a border of earth, four or five inches in height; that the water, whose emissive power is nearly equal to that of the leaves of plants, and of lamp-black, does not descend even two degrees lower than a covered thermometer placed by its side, and that frequently the ice is formed when the thermometer, elevated four or five feet, marks 5° or 6° above zero; which leads to the immediate inference, that the water lowers gradually its temperature down to the zero of the thermometric scale (centigrade), by means of a series of actions and reactions, perfectly similar to those which produce, under the same circumstances of calmness and clearness of sky, the nocturnal cooling of any other radiating matter exposed to the free air; and the decrease of the atmospheric temperature, in proportion as we approach the earth's surface.

It is in consequence of these same frigorific actions that the buds of plants, and the shallow waters of ditches and ponds, scattered here and there over the country, often freeze during the calm and clear nights of spring, whilst the thermometer marks several degrees higher than the freezing point.—*Melloni's Memoir on Dew.*—*Scientific Memoirs*, Vol. v., Part xx.

THREE IMPORTANT CHEMICAL DISCOVERIES FROM THE EXHIBITION OF 1851.

Dr. Lyon Playfair, in a Paper read by him to the Royal Institution, has thus characterized Three Important Chemical Discoveries from the Exhibition of 1851:—1. Mercer's Contraction of Cotton by Alkalies. 2. Young's Paraffine and Mineral from Coal. 3. Schrötter's Amorphous Phosphorus.

1.—*Mercer's process* consists in bringing cotton fabrics in contact with a solution of soda (cold), or a solution of dilute sulphuric acid, by subjecting it to either of which processes cotton acquires certain remarkable properties. In the first place, the texture becomes very much corrugated, and hence proportionably finer; it also assumes acid properties, rendering it more capable of taking up dyes. The process of induction which led Mr. Mercer to his final discovery was curious. He started from the point of investigating the laws which determined the flow of water at various temperatures through minute tubes. From water he proceeded to aqueous saline solutions; from tubes he proceeded to their equivalent, namely, closely-folded woven tissue. Selecting for this purpose a thick reduplication of calico, fold on fold, and employing an aqueous solution of soda, Mr. Mercer found that, by passing the solution through the calico, soda was removed. This removal he attributed to the act of filtration; *but, subsequently* finding that mere immersion of the calico in the

same solution effected a like result, he concluded that the result was due to an actual combination of the cotton with the soda—a calicoate of soda (if the lecturer might be permitted that form of expression) was generated.

The result of this agency of soda was, as formerly remarked, a physical corrugation, and an acquisition of certain chemical qualities. The former change was evident to the eye. Dr. Playfair exhibited two stockings, one of which being nearly double the size of the other, although both came equal in size from the loom. The difference had been occasioned solely by chemical, not mechanical agency. Dr. Playfair, in developing the numerous practical applications of this physical effect, showed that, besides the most obvious one of producing a material of increased fineness, the cotton thus prepared was far more capable of being dyed. Hot soda solution would not answer; and this fact was remarkable, and had its analogue in those salts which deposited themselves anhydrous on boiling. Instead of soda, sulphuric acid might be employed; in which case it formed, in combination with the cotton fibre, an easily decomposable conjugate acid.

Young's Paraffine and Mineral Oil.—Some years ago Liebig stated that one of the greatest discoveries of chemistry would consist in converting coal-gas into a solid form, thus enabling it to be burned like a candle. This had, in a manner, been accomplished by Mr. Young. About three years since, Dr. Playfair drew the attention of Mr. Young to a spring of mineral oil, containing paraffine, and occurring in a coal-mine in Derbyshire. The liquid had been extensively applied by Mr. Young as a lubricating agent; a use which Reichenbach had long ago suggested. After a period, however, this spring ceased to flow, when Mr. Young applied himself to an investigation of the theoretical conditions under which it might be artificially formed. This gentleman saw that it would be difficult to convert gas into an allotropic form, whereas it was evident that gas must first come from a solid; hence he hoped to succeed in procuring the body before it assumed its gaseous state. The illuminating portion of coal gas consists chiefly of olefiant gas, and the latter is isomeric with solid paraffine. But the allotropism does not end here; the peculiar slow distillation of coals yielding solid paraffine, also yielded another isomeric or allotropic compound in the form of a lubricating oil, besides the additional products of a burning oil, and naphtha. Dr. Playfair now explained, by the aid of a diagram, the slow distillation process of Mr. Young, employed in generating his allotropic form of olefiant gas, and directed the attention of his audience to some candles made of coal paraffine on the lecture table.

Schrötter's process of manufacturing Amorphous or Allotropic Phosphorus was the third in Dr. Playfair's series. The properties of phosphorus in its ordinary condition are well known. It is spontaneously inflammable and highly poisonous; whereas the amorphous or allotropic phosphorus is neither spontaneously inflammable nor poisonous. Hence its great use in the manufacture of lucifer

and congreve matches; an operation which not only imperilled the premises wherein it is conducted, but also the lives of those conducting it, causing the most frightful and fatal disease of the jaws and facial bones. Common phosphorus, when heated to about 480 or 490, changes into the allotropic condition, but a slight increment of heat changes it back again. Hence the manufacture of this substance on a large scale is attended with difficulties which Dr. Playfair had no doubt would be eventually overcome by the energy of Mr. Sturge the patentee. The specific gravity of ordinary phosphorus is 1·77—of amorphous phosphorus, 1·964. Common phosphorus is soluble in bisulphuret of carbon, whereas the amorphous variety is not. Common phosphorus bursts into flame when brought into contact with iodine, whereas the amorphous or allotropic variety does not. Common phosphorus is luminous at very low temperatures, whereas the amorphous variety only commences to be luminous at a temperature of 500° Fr. In forming lucifer matches by means of allotropic phosphorus, there is experienced the difficulty that it does not ignite by friction; hence it has to be mixed either with chlorate of potash, oxide of lead, or sulphuret of antimony, when friction takes effect and generates flame.

The experimental portion of Dr. Playfair's lecture was preceded and followed by statements and arguments, embodying considerations which he wished to impress on the members of the Royal Institution.

SOLAR RADIATIONS AND VITALITY OF PLANTS.

There has been communicated to the British Association, a "Report on the Influence of the Solar Radiations on the Vital Powers of Plants growing under different Atmospheric Conditions," by Dr. J. H. Gladstone. As a preliminary matter of inquiry, the mere effect of coloured media in accelerating or retarding the growth of various kinds of plants was tried. Hyacinths were chosen as the sample of bulbous-rooted plants. Roots of as nearly as possible the same size and description in every respect were grown under the various bell-glasses. Certain differences were described, both in the rootlets and the leaves, which might fairly be attributed to the character of the light; the time of flowering, and the flowers themselves were not affected by it; and the greatest growth (estimated quantitatively in each instance) took place in the plant exposed to all the rays of the solar spectrum; the next greatest was under the blue glass. Wheat was also grown in a similar manner; the method of arrangement of apparatus being minutely detailed, and the character of the corn-plants which appeared under the various glasses. Those under the yellow were the most sturdy in their growth; those under the blue the least healthy; whilst some grown under a nearly darkened shade grew quickly nine inches long, put forth no secondary leaves, and died in a month. Mallows were grown in a similar manner. The detailed observations were to much the same purport as in the preceding instance. As it had been formerly observed by

the author and his brother, that plants kept in an unchanged atmosphere appear to enter into a sort of lethargic condition, experiments were instituted for the purpose of ascertaining whether the alteration in light produced by coloured media made any marked variation in this matter. The pansy and the *Poa annua* were the plants selected; and comparative experiments were made with a darkened shade and with no covering at all. The results were various,—but scarcely conclusive, unless in reference to the fact that plants survive much longer for being in unchanged air. The colourless and yellow media appeared most favourable to the healthiness of the plants. As experiments on growing plants must stretch over a considerable time, the author's observations were not put forth as foundations for any generalization, but just as samples of his preliminary attempts.

EARLY EGYPTIAN CHEMISTRY.

MR. W. HERAPATH, of Old Park, Bristol, writes thus to the *Philosophical Magazine*, No. 21:—"While engaged in unrolling a mummy at the Bristol Philosophical Institution lately, I elicited a few chemical facts which might probably be interesting to some of your readers. On three of the bandages were hieroglyphical characters of a dark colour, as well defined as if written with a modern pen; where the marking fluid had flowed more copiously than the characters required, the texture of the cloth had become decomposed and small holes had resulted. I have no doubt that the bandages were genuine, and had not been disturbed or unfolded: the colour of the marks were so similar to those of the present 'marking-ink,' that I was induced to try if they were produced by silver. With the blowpipe I immediately obtained a button of that metal; the fibre of the linen I proved by the microscope, and by chemical reagents, to be linen; it is therefore certain that the ancient Egyptians were acquainted with the means of dissolving silver, and of applying it as a permanent ink; but what was their solvent? I know of none that would act upon the metal and decompose flax fibre but nitric acid, which we have been told was unknown until discovered by the alchymists in the thirteenth century, which was about 2200 years after the date of this mummy, according as its superscription was read. A very probable speculation might be raised upon this to account for the solution of the golden calf by Moses, who had all his mundane knowledge from the Egyptian priests. It has been supposed that he was acquainted with and used the sulphuret of potassium for that purpose: how the inference arose I know not; but if the Egyptians obtained nitric acid, it could only have been by the means of sulphuric acid, through the agency of which, and by the same kind of process, they could have separated hydrochloric acid from common salt: it is therefore more probable that the priests had taught Moses the use of the mixed nitric and hydrochloric acids with which he could dissolve the statue, rather than a sulphuret, which we have no evidence of their being acquainted with.

"The yellow colour of the fine linen cloths which had not been stained by the embalming materials, I found to be the natural

colouring matter of the flax; they therefore did not, if we judge from this specimen, practise bleaching. There were in some of the bandages near the selvage some twenty or thirty blue threads; these were dyed by indigo, but the tint was not so deep nor so equal as the work of the modern dyers; the colour had been given it in the skein.

One of the outer bandages was of a reddish colour, which dye I found to be vegetable, but could not individualize it; my son, Mr. Thornton J. Herapath, analysed it for tin and alumina, but could not find any.

The face and internal surfaces of the orbits had been painted white, which pigment I ascertained to be finely powdered chalk.

A paper by Mr. L. J. D. Smith, dissenting from Mr. Herapath's deductions in the above communication, will be found in the *Philosophical Magazine*, No. 23.

CHEMISTRY AND PERFUMERY.

Dr. Lyon Playfair in a lecture to the Society of Arts, observes: Much aid has been given by Chemistry to the art of Perfumery; and perfumers, if they do not occupy whole streets, as they did in ancient Capua, show more science in attaining their perfumes than those of former times. The jury in the Great Exhibition, or rather, two distinguished chemists of that jury, Dr. Hoffman and Mr. Delarue, ascertained that some of the most delicate perfumes were made by chemical artifice, and not, as of old, by distilling them from flowers. The perfume of flowers often consists of oils and ethers, which the chemist can compound artificially in his own laboratory. Commercial enterprise has availed itself of this fact, and sent to the Exhibition, in the form of essences, perfumes thus prepared. Singularly enough, they are generally derived from substances of intensely disgusting odour. A peculiarly fetid oil, termed 'fusel oil,' is formed in making brandy and whisky. This fusel oil, distilled with sulphuric acid and acetate of potash, gives the oil of pears. The oil of apples is made from the same fusel oil by distillation with sulphuric acid and bichromate of potash. The oil of pine-apples is obtained from a product of the action of putrid cheese on sugar, or by making a soap with butter, and distilling it with alcohol and sulphuric acid, and is now largely employed in England in the preparation of the pine-apple ale. Oil of grapes and oil of cognac, used to impart the flavour of French cognac to British brandy, are little else than fusel oil. The artificial oil of bitter almonds, now so largely employed in perfuming soap, and for flavouring confectionery, is prepared by the action of nitric acid on the fetid oils of gas tar. Many a fair forehead is damped with eau de millefleurs, without knowing that its essential ingredient is derived from the drainage of cow-houses. The winter green oil, imported from New Jersey, being produced from a plant indigenous there, is artificially made from willows and a body procured in the distillation of wood. All these are direct modern applications of science to an industrial purpose, and imply an acquaintance with the highest investigations of organic chemistry. Let us recollect that the oil of lemons, turpentine, oil of juniper, oil

of roses, oil of copaiba, oil of rosemary, and many other oils are identical in composition; and it is not difficult to concive that perfumery may derive still further aid from chemistry.

COMPOUNDS OF COTTON WITH THE ALKALIES.

DR. J. H. GLADSTONE has communicated to the Chemical Society, a paper on this inquiry, wherein he first described the process of Mr. Mercer, by which the beautiful fabrics made known to the public through the Great Exhibition are produced.* When cotton, or an article made of that material, is immersed in strong caustic soda in the cold, a certain combination is effected—which is again destroyed by pure water; but the "Mercerized" cotton thus produced is permanently contracted, and rendered more susceptible of dyes. This was illustrated by a number of specimens, much shrunk, so that they assumed an appearance of extraordinary fineness, others puckered in patterns by partial Mercerization, and others again printed with colours which surpassed in depth and brilliancy the colours produced by the same means on the calico in its original state. Dr. Gladstone proceeded to detail experiments by which he had succeeded in obtaining the compound of cotton and soda free from adhering alkali, through the agency of strong, sometimes absolute, alcohol. He found that the proportion of soda which combined with the lignine varied with the strength of the solution employed, but under no circumstances exceeded one atom. There was a varying amount of combined water. Some properties of this compound were discussed, and the author then proceeded to state his conviction, that there was no sufficient ground for viewing the "Mercerized" cotton as chemically different from the original lignine. It is identical in composition, and the change of properties may be accounted for by the change in its physical condition. When viewed under the microscope, the fibres in their ordinary condition appear as flattened twisted ribands; but the moment they are touched by the alkaline ley they untwist themselves, contract in length, and swell out, assuming a rounded solid form; and this circular appearance they retain after the soda is removed by water. This not only explains the shrinking, but the cause of a larger quantity of dye being absorbed as the substance of the fibre itself is porous. Potash has a similar action to that of soda.—*Athenæum*, No. 1299.

CHEMICAL COMBINATION.

IN a paper read to the British Association, Dr. Wood summed up his opinions as follows :—"I conceive that there is a mutual dependence or relation between the space and the matter which compose a body, such relation causing the distance between the particles to be definite; that, therefore, if the nature of the matter changes, the distance between its particles must also change; that, if two bodies be mixed or brought together, at insensible distances, as in solution,

* See Dr. Lyon Playfair's lecture upon this process, at page 158.

they are no longer two but one body,—and, as they were dissimilar previously to being mixed, the one body they form must be dissimilar from either separately, and so the distance between the particles must be different. It must also be less; for, if greater, the bodies could be brought nearer at sensible than insensible distances, and so could not form one body at all, which is contrary to our supposition. But, as every molecular movement is accompanied by its opposite, this lessening of distance between combining particles is attended with expansion among others, and this expansion is the heat."

In the paper next read—"On Combinations of Metals with Oxygen," by Dr. T. Wood, and indeed in the preceding one, the author referred to his published views of the production of cold by decomposition, and especially to a paper in the *Philosophical Magazine*, for October, 1851, where he proved "that the decomposition of a compound body gives rise to as much cold as the combination of its elements produces heat."

Dr. Andrews, at the conclusion, made some observations, and said he considered it but fair to refer to his paper on a similar subject published in the *Phil. Mag.* for June, 1848, where the same discovery was announced by himself in these words:—"This assumes the truth of the principle (which I have in other inquiries endeavoured to illustrate, and is indeed almost self-evident), that when, in the course of any chemical reaction, the constituents of a compound are separated from one another, there is a quantity of heat thereby absorbed equal to that which would have been evolved if the same substances had entered into combination."—*Ibid.*

ON THE PASSIVE STATE OF METEORIC IRON.—BY PROF. WÖHLER.

I HAVE observed the remarkable fact that the greater portion of the Meteoric Iron which I have had the opportunity of examining, is in the so-called passive state; that is to say, that it does not reduce the copper from a solution of neutral sulphate of copper, but remains bright and uncoppered on immersion therein. But if touched in the solution with a piece of common iron, the reduction of the copper commences immediately upon the meteoric iron. It also becomes active instantaneously on the addition of a drop of acid to the solution of copper; but if the reduced copper be filed away, the new surface is again passive; indeed I was unable by filing away to produce an active or reducing surface on any passive meteoric iron. I convinced myself by experiments on meteoric iron, which had never been in contact with nitric acid and nevertheless was passive, that this state could not have been produced by the corrosion of the surface by the acid for the production of the Widmanstättean figures.

I thought at first that this deportment might be employed as a means of distinguishing true meteoric iron; but it soon appeared that some undoubtedly genuine meteoric iron was not in this state. In this respect I have observed the following differences:—

The Pallas iron, the iron which fell at Brannau in 1847, that of *Schwetz, Bohumilitz,* Toluca, Green County (N. America), Red *River, and that* from the Cape of Good Hope, are passive.

The iron from Lenarto, Chester County, Rasgata, Mexico, Senegal and Bitburg (the latter forged), is *active* or *reducing*.

Between the two stands the iron from Agram, Arva, Atacama and Burlington (N. America), which do not become coated with copper immediately, but on which the reduction gradually commences after a longer or shorter contact with the cupreous solution, and usually from one point or from the margins of the fluid.

These peculiarities appear to have no connexion either with the presence of nickel or the property of forming regular figures on corrosion, as is shown by the iron from Lenarto, which is active, although it contains 8·45 per cent. of nickel and 0·66 of cobalt, and exhibits the most beautiful figures on corrosion; and also by the iron brought by Boussingault from Rasgata in Columbia, which, according to my analysis, contains 6·74 per cent. of nickel and 0·23 of cobalt. On the other hand, the iron from Green County, which is completely passive, contains 19 per cent. of nickel and exhibits no figures.

I also found that an artificially prepared alloy of iron and nickel, which on corrosion acquired a damasked surface, reduced the copper from solution in the same manner as common iron.

Whether this state is proper to all meteoric iron on its reaching the earth, and, as may have happened in the case of the active kinds, have only been lost in the course of perhaps a very long period of time, and what probable opinion can be formed of these phenomena, must be settled by experiments and observations of a more extended nature.—Poggendorff's *Annalen; Philosophical Magazine*, No. 20.

ATOMIC WEIGHTS OF PLATINUM AND BARYTES.

A PAPER on this investigation has been read to the British Association, by Dr. Andrews. No determination of the Atomic Weight of Platinum having been made since the recent revision of atomic weights, and the number adopted by chemists for that metal resting on the authority of a single experiment of Berzelius, the author considered it of importance on practical as well as theoretical grounds to institute some new experiments on the subject. The salt of platinum selected was the double chloride of potassium and platinum; which, after being dried in vacuo, at a temperature of 105° C., was decomposed by digestion with metallic zinc and a small quantity of water, the action being assisted by the application of heat towards the end of the process. After the complete precipitation of the platinum and the formation of chloride of zinc from the decomposition of the double salt, the excess of zinc was removed by the addition, first, of acetic, and subsequently of nitric acid. The precipitated platinum was then removed by means of a small and carefully washed filter, and the amount of chlorine in the solution of chloride of zinc ascertained by Gay-Lussac's process, which has been of late so successfully applied by Pelouze to the determination of several other atomic weights. The double chloride of potassium and platinum was found to retain 55-10000ths of its weight in moisture, even when dried at a temperature considerably superior to the boiling-point

of water. In three experiments performed by this process, the numbers obtained were 98·93, 98·84, and 99·06; the mean number 98·94 expresses, therefore, the atomic weight of platinum. For the atomic weight of barium, the author obtained from two closely accordant experiments the number 68·789; and concluded with some general observations as to the importance of a systematic series of experiments to settle, if possible, definitely, whether the law of Prout, that the atomic weights of all bodies are multiples of that of hydrogen, be universally true. He concluded by reading this interesting extract from a letter which he had received from Baron Liebig: "It is not certain that Prout's law may not be true for oxygen, nitrogen, and carbon, without its being necessary to assume, as a consequence, that other bodies behave similarly,—that is, that their atomic weight must be exactly multiples by whole numbers of the atomic weight of hydrogen. The law is certainly not true of all bodies, but it may be true of certain groups, whose members, in respect to atomic weight, stand in a simple numerical relation to each other. The atomic weights of silicum, cobalt, strontium, tin, arsenic, and lead, are in the same ratio as the numbers 1 : 2 : 3 : 4 : 5 : 7. We do not see the necessity of this relation, but only the possibility. Why should fractional numbers only occur, and not whole numbers also? I consider these relations only as facts: the law of the numbers themselves is quite unknown to us,—as unknown as the absolute weights of the atoms."—*Athenæum*, No. 1299.

DISTRIBUTION OF IODINE.

M. AD. CHATIN, in a paper "Upon Iodine in the Air, the Water, the Soil, and the Alimentary Products of the Alps of France and of Piedmont," thus classes the relations which exist between iodine, goître, and cretinism:—

First zone, normal, that of Paris.—Goître and cretinism are unknown. We find that, in this zone, on an average, the volume of air respired by men in 24 hours is from 7000 to 8000 pints (litres, according to M. Dumas): the quantity of water drunk, and of food consumed, during the same time, each include from 1-100th to 1-200th of a milligramme of iodine.

Second zone, that of Soissonnais.—Goître is more or less rare, cretinism is unknown. It differs from the first zone only in the waters being hard, and being deprived of iodine.

Third zone, that of Lyons and Turin.—Goître is more or less frequent, cretinism is almost unknown. The proportion of iodine has descended from 1-500th to 1-1000th of a milligramme.

Fourth zone, that of the Alpine valleys.—Goître and cretinism are endemic. The proportion of iodine in the quantity of air, water, and food, consumed in a day, is at most 1-2000th of a milligramme.

In the intermediate zones the goître is subordinate to the general influences; in the fourth zone the deficiency of iodine preponderates.

We can do something to prôcure the iodine in the normal proportion: in the second zone by collecting the rain water: in the inter-

mediate zones by the same waters, by making a choice of the springs, and by procuring food from those countries which are rich in iodine; in the fourth zone by the use of the preceding aliments, and of sulpho-iodine waters, after being deprived of sulphur, lavished by nature on the districts most afflicted with goitre, as well as by the use of iodurated salts, already advised by M. Boussingault and by M. Jules Grange. Animal and vegetable productions became iodurated by the use of saline waters, for drinking and in irrigations, as well as by the warm solutions procured by alkaline water from the most ferruginous soils and rocks.—*Jameson's Journal*, No. 104.

Mr. Stevenson Macadam, in a paper communicated to *Jameson's Journal*, No. 105, observes, that the presence of iodine in pearl ashes leads him to believe that this substance will be found more generally distributed in the vegetable kingdom than it has hitherto been supposed to be; and this opinion is strengthened by the fact that he has found an appreciable quantity of iodine in the ashes of charcoal.

While this element and Fluorine appeared to be confined within the narrow limits of a portion of one kingdom of nature, we could not understand their value in the chemical constitution of nature. Now, however, that iodine and fluorine, which have many properties in common, are traced through the earth, the waters and the air—and those organic creations which exist in them,—we begin to appreciate their importance.

IMPORTANT USES OF IODIFEROUS COMPOUNDS.

From the important researches of M. Boussingault, it appears that the inhabitants of the Cordilleras of New Granada, where cretinism and goitre are endemic, now avert these evils by the use of an iodiferous salt extracted from the numerous saline springs of that country; and M. A. Fourcault recommends to the inhabitants of mountain districts where goitre and cretinism are endemic, the use of iodurate of potassa along with common salt: he is also of opinion, that iodurets will prove very useful in districts where scrofula and pulmonary consumption prevail.—*Jameson's Journal*, No. 104.

FLUORINE IN PLANTS.

Dr. George Wilson, in a paper read to the Botanical Society of Edinburgh, concludes:—1st, That Fluorine occurs in a large number of plants; and, That it occurs in marked quantity in the siliceous stems of the *Gramineæ* and *Equisetaceæ*; 3rd, That the quantity present is in all cases very small, for although exact quantitative results were not obtained, it is well known that a fraction of a grain of a fluoride will yield, with oil of vitriol, a quantity of hydrofluoric acid sufficient to etch glass deeply, so that the proportion of fluorine present, even in the plant-ashes which contain it most abundantly, does not probably amount to more than a fraction per cent. of their weight. The proportion of fluorine appears to be variable, for different specimens of the same plant did not yield concordant results.

In this, however, there is nothing anomalous, for some Bamboos

yield Tabasheer largely, whilst others are found to contain none. It seems not unlikely that soluble fluorides ascending the siliceous stem of a plant, on their way to the seeds of fruits in which they finally accumulate, may be arrested by the silica, and converted into insoluble fluosilicates (fluorides of silicon and of a metal); and a Bamboo, for example, secreting Tabasheer, may effect this change where one less rich in silica cannot determine it. The slow or quick drying of a stem may also affect the fixation of fluorides in the stems or trunks of plants.

The sources of the fluorine found in plants may be regarded as pre-eminently two:—(1.) Simple fluorides, such as that of calcium, which are soluble in water, and through this medium are carried into the tissues of plants; and (2.) Compounds of fluorides with other salts, of which the most important is probably the combination of phosphate of lime with fluoride of calcium. This occurs in the mineral kingdom in apatite and phosphorite, and in the animal kingdom in bones, shells and corals, as well as in blood, milk, and other fluids.

The recent discovery of the author's communicated to the Royal Society of Edinburgh, (see *Jameson's Journal*, No. 106,) has shown that fluorides are much more widely distributed than is generally imagined, and that the trap rocks near Edinburgh, and in the neighbourhood of the Clyde, as well as the granites of Aberdeenshire, and the ashes of coal, contain fluorides, so that the soils resulting from the disintegration of those rocks cannot fail to possess fluorides also. All plants, accordingly, may be expected to exhibit evidences of their presence, in the following portions of their tissues or fluids:—

1. In the ascending sap, simple fluorides.
2. In the descending sap, in association with the albuminous vegetable principles, and in the seeds or fruits, in a similar state of association, fluorides along with phosphates
3. In the stems, especially when siliceous and hardened, fluorides in combination with silica. The investigation is still in progress.

POTASH AND SODA IN PLANTS.

PROFESSOR DAUBENY has read to the Chemical Society, a Paper "On the Variation in the relative Proportion of Potash and Soda present in certain samples of Barley grown in Plots of Ground artificially impregnated with one or other of these Alkalies." The author detailed some experiments undertaken by him at the Oxford Botanic Garden, with the view of determining whether the usual quantity of potash and soda existing in barley might be made to vary by causing the plant to grow in soil impregnated with more than the ordinary quantity of one or the other of these alkalies. He found that when the barley had grown in a soil which had been dressed with a strong solution either of carbonate of soda or of chloride of sodium, the ashes of the plant contained about eight per cent. more soda than was present when the plant had grown in a *soil impregnated* with carbonate of potash, or left unimpregnated.—

This difference may admit of explanation by supposing one alkali capable of replacing the other within the organism of the plant; but the author thinks it more probable that it arose from the sap circulating through the plant at the time when it was cut containing in the one case more soda than it did in the other. The saline contents of the fluid of the sap would of course be confounded with those which had been actually assimilated by the plant; and hence, from the variation in its composition, must tend to modify the amount of the alkalies obtained from the ashes of the plant in each instance according to the nature of the material with which the soil had been impregnated.

ON THE GREEN COLOURING MATTER OF PLANTS, AND ON THE RED MATTER OF THE BLOOD.

THE green matter which can be extracted from the majority of plants by means of alcohol or æther has been considered as a pure homogeneous organic substance, and received the name of *chlorophylle*, or green resin of plants.

M. Verdeil has discovered that this green resin is a mixture of a perfectly colourless fat capable of crystallizing, and of a colouring principle presenting the greatest analogies with the red colouring principle of the blood, which however had never yet been obtained in a completely pure state.

To isolate it, M. Verdeil precipitates a boiling solution of chlorophylle in alcohol by a small quantity of milk of lime. The solution becomes colourless; the alcohol retains the fat, whilst the lime precipitates all the colouring matter. This is separated from the lime by hydrochloric acid and æther, which dissolves the green matter, forming a coloured stratum at the top of the liquid. By evaporating the æther, the colouring matter is obtained in a state of perfect purity.—*Comptes Rendus*; *Philosophical Magazine*, No. 19.

SOURCES OF COMMON SALT.

A PAPER has been read to the British Association, "On the Sources of Common Salt," by Mr. W. Bollaert. Extracts were given of the author's view, that the masses of rock salt in beds were the result of volcanic agency, rather than deposits from the ocean.

LIGHT FOR ILLUMINATION OBTAINED FROM THE BURNING OF HYDROGEN.

WE have had an opportunity (says Mr. B. Silliman, jun.) of seeing the successful application of M. Gillard's patent in the extensive silver plate works of Messrs. Christolef in Paris. It is well known that M. Gillard claims the production of a useful light and great heat from the combustion of hydrogen in contact with a coil of platinum wire, the hydrogen being produced by the decomposition of water. The apparatus employed is very simple, and consists essentially of one or more cylinders of iron arranged horizontally in a furnace similar in all respects to the usual arrangement for the production of

coal-gas. The retorts are charged with wood-charcoal reduced to small fragments of uniform size and heated to an intense degree. Through each of the retorts steam is conducted in a tube pierced with numerous very minute holes so disposed as to distribute the steam in a uniform and very gradual manner over the heated coal. The boiler for the production of the steam is conveniently situated in the same furnace employed for heating the retorts. Decomposition of water ensues of course, accompanied with the production of carbonic acid (CO^2), carbonic oxide (CO) in small quantity, of free hydrogen and a limited quantity of light carburetted hydrogen gas (C^2H). The mixture of these gases is conducted through a lime purifier to remove carbonic acid, and without further washing or purification the product is ready for use. Consisting almost wholly of hydrogen gas, the flame of its combustion is of course very feebly luminous; to obviate this difficulty, it is burned in contact with a cage or network of platinum wire-gauze surrounding an ordinary Argand burner, protected by a glass chimney. This simple contrivance (so well known in the lecture-room) is perfectly successful, and the light given out from gas lamps of this construction is extremely vivid and constant.

This invention claims the following advantages in practice:—1. The gas so produced is cheaper than any other mode of artificial light, costing, as is asserted by M. Gillard, and sustained by the ample experience of M. Christolef, only about 1-16th the average cost of coal-gas. 2. The gas has no unpleasant odour, being entirely free from the volatile hydrocarbons which are so peculiarly offensive in oil and coal-gas. 3. The products of its combustion are almost solely water, so little carbonic acid resulting in the combustion, that practically it may be disregarded. 4. This mode of producing gas may be applied to any existing gas-works by a slight modification of the retorts, and without any essential change in other portions of the apparatus, the platinum cages being applied to the Argand burners. 5. The cheapness of this mode enables us to apply it with great advantage as a fuel for cooking and for numerous purposes in the arts. For example, we saw in the establishment of M. Christolef, the soldering of silver plate accomplished in a rapid and remarkably neat manner by a powerful jet of this gas, driven by a pneumatic apparatus. Its perfect manageableness, the ease with which an intense heat is applied locally and immediately when it is wanted, coupled with advantages of employing for such a purpose so powerful a deoxidizing agent as hydrogen, render this mode of soldering preferable to every other, and peculiarly suited for the process of autogenous soldering. 6. The nuisances resulting from the presence of large coal-gas works in populous districts are entirely avoided by this mode, which is as free from objection as a steam-engine. 7. The arrangements are so simple and inexpensive, that every establishment, where it is desired to employ light and heat, may erect its own apparatus even in the most isolated situation, all the materials employed being everywhere accessible.

It is understood that M. Gillard has secured his patent in the

United States, and it is presumed that his method will soon be practically tested there.

We merely add that the result of M. Gillard's invention in one particular differs from the anticipation of chemists: that is, we should expect from the decomposition of water in this mode the production of carbonic oxide CO, carbonic acid CO^2, and light carburetted hydrogen G^2H, with a limited amount of free hydrogen. The result of his experience, however, seems to establish the statements already made, as may be seen in a Report of the Commissioner of the Society for the Encouragement of Industry, &c., to whom the subject has been referred.—*Silliman's Journal.*

CAN FIRE BE PRODUCED BY THE AGENCY OF TWO STICKS?

A CORRESPONDENT of the *Lancet*, writing from Fort Vancouver, states that from inquiries among the Hudson's Bay Company's officers, he has no doubt that the Indians produce fire by rubbing two sticks together. He was informed by Captain Mount, that all the way north from the Straits of St. Juan de Fuca, the practice is very general. Lieutenant Talbot, of the United States Army, who was with Colonel Fremont's expedition, also states, that to the south of the Columbia, and also to the east of the Sierra Nevada, are many tribes who have no other means of producing fire, as they have no iron among them. In the Snake Country, also, or south branch of the Columbia, an Indian is not considered properly equipped without his fire-stick, which is always attached to his quiver.

ON OZONE.

MM. ED. BECQUEREL and FREMY have recently confirmed the observation, already made by others, that Ozone may be produced in the purest possible oxygen when this is subjected to the influence of electrical discharges. These physicists are on this account of opinion that ozone is to be regarded as allotropic oxygen, and propose to call it "*Oxygène électrisé.*" M. Schönbein considers this term inappropriate, and the grounds are given in the *Journ.-für Prakt. Chem.*, translated in the *Philosophical Magazine*, No. 28.

M. SCHÖNBEIN writes in the *Journ.-für Prakt. Chem.*:—

"My recent experiments have proved that atmospheric air may be ozonized to the extent of 1·1300 by means of phosphorus; and did not Ozone act so energetically upon phosphorus, a much higher degree of ozonization might be attained. At this point, however, the production and consumption of this substance appear to be equal, and ignition of the phosphorus takes place in consequence of the rapid oxidation.

"I have already often pointed out the great similarity between the effects produced by chlorine and ozone. One instance of this is the fact that like chlorine it combines with phosphorus at ordinary temperatures. There can therefore be no doubt that this body would immediately take fire in pure ozone gas, as in chlorine, even in the cold.

"As the test-solution of indigo employed is very dark blue, it

may be very greatly diluted, and still appear deeply coloured. I therefore employ two more dilute solutions of such a strength, that 10 grms. of one is decolorized by 1·10 milligrm., and 10 grms. of the other by 1·100 milligrm. of oxygen. By this means it is evident that even very small fractions of a milligrm. of ozone may be detected and estimated.

"With this very delicate reagent I have found that ozone diluted with 500,000 times its volume of atmospheric air may still be recognised by its smell, sufficiently proving that the pure ozone must have a most intense odour."

COLOUR OF A JET OF STEAM.

PROF. J. D. FORBES, from some recent experiments communicated to the *Philosophical Magazine*, No. 23, states the colours of the steam jet to be manifestly only instances of ordinary interference, greatly resembling that produced by thin transparent plates; the transmitted ray being always complementary to the reflected. Thus, in a jet wherein the transmitted light is red, the reflected light is blue. It is, therefore, to be inferred that all the colours of the clouds originate in interference caused by minute drops of water, the size of which determines their colour; while the blue jet is strictly analogous to the blue sky.

APPLICATION OF OPTICAL PHENOMENA TO CHEMISTRY.

AT the late Meeting of the British Association, Prof. Stokes, with the aid of prisms and experiments, and referring to diagrams, gave an account of the dark lines or bands in the spectrum, or prismatic fringes of light; adding that by the interposition of small portions of chemical substances in solution, and in other cases, as by the beads formed by the blowpipe, and on examination, optical means would discover the presence of many bodies by their power upon light. Arguing upon the advantage of this auxiliary power to the chemist, he pointed out the facility with which trials could be made. The salt of per-oxide of uranium, for instance, has a property of showing dark lines in a certain portion of the spectrum, and on one occasion he discovered on a blowpipe bead the lines that were usually associated with the presence of uranium; in that instance he had no reason to expect it could be present, and upon careful attention he found that he had used a platina wire that had been employed with experiments where uranium had been present; and a minute quantity must have remained attached to the wire, and thus become evident. He took a single case of difficulty and where doubt still remained, to call the attention of chemists to the value of optical research where ordinary tests did not avail. He found that manganesic acid in solution had a certain power over light, giving dark bands. There was a class of crimson solutions of manganese which some chemists supposed the per-oxide in solution, and others a different oxide; but Mr. Pearsall, in the *Royal Institution Journal*, had shown the probability that manganesic acid was present: this was a fair case, and accordingly by optical means he decided that manga-

acid was not present. He had considered the effects of acids
ases, but sulphuric acid and potassa made no difference if added
nganesic acid. He held this to be a fair case, when no test
een devised to settle the point. Prof. Stokes showed the effect
balt, uranium, solution of chlorophylle, sulphate of quinia, and
substances, and gave this verbal statement of the application
ical researches to abridge chemical labour at the desire of the
s of the Sections. Prof. Stokes having recommended a "dumpy
" to be used for experiments, Sir D. Brewster called attention
e prisms of rock salts, which he had formerly used and
mended.

conversation between Prof. Graham, Dr. Andrews, Dr. Apjohn,
Pearsall, and others, then took place on the importance of a
ledge of optical properties to act as auxiliaries to test in che-
researches.

POLARIZED LIGHT FOR CHEMICAL EXAMINATIONS.

. Andrews has read to the British Association, a paper on the
cation of Polarized Light to the discovery of minute quantities
da.—The author stated that the double chloride of potassium
latinum showed no depolarized action when placed in the dark
of the polariscope; but the double salt of sodium and platinum
emarkable for its depolarizing power, and that a minute trace of
alt, invisible to the naked eye, could readily be detected by the
ant display of prismatic colours when under the action of
ized light. The delicacy of the test is such that the soda can
tected when in a quantity so minute as the 1,000,000th part of
in.

ARTIFICIAL FORMATION OF MINERALS.

Becquerel, in a paper in the *Comptes Rendus*, details certain
proving "two principles, by the aid of which a certain number
soluble Crystalline Compounds may be produced similar to the
ral ones." The first consists in slowly oxidizing a body in a
ion of substances, upon which the oxide form reacts, and whence
t oxides and various crystallized insoluble compounds. The
d relates to the feeble reactions which take place when a slightly
le body is placed in contact with a solution containing several
ounds, giving rise to double decomposition, in which case
uble compounds are formed, which crystallize.—(See the entire
r in the *Philosophical Magazine*, No. 17.)

EQUIVALENT OF PHOSPHORUS.

of. Schrötter has determined the Equivalent of Phosphorus by
ing amorphous phosphorus in oxygen gas. A mean of ten de-
inations, which scarcely differ, gave as the true equivalent
5 on the oxygen, or 31 upon the hydrogen scale. One gramme of
phorus according to this yields, on burning, 2·289186 grms. of
phoric acid. Pelouze's determination, 32, is consequently too
—*Journal für Praktische Chemie; Philosophical Magazine,*
19.

PRODUCTION OF CYANIDE OF POTASSIUM.

M. RIEKEN has confirmed by careful experiments the results of Bunsen and Playfair, that Cyanide of Potassium is formed when carbonate of potash intimately mixed with carbon is heated to whiteness in a current of previously heated nitrogen gas. The temperature must be that at which potassium is formed, and the nitrogen must be strongly ignited before passing over the mixture. The necessity of fulfilling these conditions will render the process very difficult of execution upon a large scale.—*Ann. der Chemie und Pharmacie; Philosophical Magazine*, No. 19.

MADDER.

MR. E. SCHUNCK, F.R.S., in a paper communicated by him to the Royal Society, "On Rubian and its Products of Decomposition," gives the results of some experiments undertaken with the view of ascertaining whether Madder contains more than one colouring matter or not. He infers from his experiments, that the purpurine of other chemists is not a substance of determinate composition; that it consists sometimes of alizarine alone, sometimes of verantine alone, sometimes of a variable mixture of both; that only one colouring matter, viz., alizarine, can be obtained from madder; that purpurine, madder-purple, and the various similar bodies derived from madder, owe their property as colouring matters to an admixture of alizarine; and that they are simply the latter substance in a state of impurity.

ON THE INDIRECT BLEACHING POWER OF MERCURY AND STYBÆTHYLE.
BY C. F. SCHÖNBEIN.

I HAVE long since shown that mercury possesses the power of communicating to oxygen that condition in virtue of which it colours guaiacum tincture blue, decomposes iodide of zinc, &c., and produces those general oxidating effects which are caused by ozone. The fact that the latter destroys organic colouring matters, suggested the idea that oxygen under the influence of mercury would likewise effect this change, and the following experiments prove that this is really the case.

When 200 grms. of mercury and 10 grms. of water, sensibly coloured with indigo solution or an alkaline indigo-sulphate, are shaken briskly for some time in a tolerably capacious flask containing oxygen or atmospheric air, it is decolorized precisely as if it had been treated with ozone, chlorine or oxygenized turpentine, &c. Elevation of temperature quickens this decolorization. Water coloured by cochineal or logwood may be decolorized in a similar manner, whence it may be inferred that oxygen in contact with mercury is capable of destroying all organic blue and red colours. I have recently fully described the decolorization of indigo solution by oxygen in contact with phosphorus; it may therefore be said that mercury acts upon vegetable colours like phosphorus, though in a much weaker degree; that is to say, both bodies, like so many other *inorganic and* organic bodies, possess an indirect power of bleaching.

If platinum, gold and silver were volatile at ordinary temperatures, they would also destroy organic colouring matters when shaken with their aqueous solutions and oxygen. Some years ago I showed that moistened paper coloured with indigo solution was bleached in 24 hours by contact with spongy platinum.

During the last year Prof. Löwig and myself made some experiments in the laboratory at Zurich upon stibæthyle, in order to test its power of bleaching, and it turned out that this remarkable body destroyed the colour of indigo solutions still more energetically than even phosphorus. We added a small quantity of stibæthyle to a comparatively large amount of indigo solution, shook the whole with atmospheric air, and found that the colour was destroyed in a few seconds.

There can be no doubt that stibmethyle, kakodyle and similar compounds would act like the stibæthyle. These substances are so oxidizable that they take fire in atmospheric air even, at the ordinary temperature; and it may be inferred that they are more powerful exciters of oxygen than phosphorus, and consequently possess a great power of bleaching.—*Philosophical Magazine*, No. 24.

SUNFISH OIL.

At the late meeting of the British Association, Dr. Ronalds, Professor of Chemistry at Galway, brought forward the subject of the Oil obtained from the liver of the immense Sunfish caught on those shores. It is remarkable as being the oil of lowest specific gravity known, and he thought it might be brought into use in many ways, affording a new branch of industry for the fishermen of that destitute region, especially as with an improved method of capture many more fishes than at present might be easily taken.—*Literary Gazette*, No. 1861.

CHLORIDE OF ARSENIC.

Dr. Penny and Mr. W. Wallace, in a paper communicated by them to the Philosophical Society of Glasgow, state that the several experiments detailed therein, plainly indicate the availability of the Chloride of Arsenic in medico-legal investigations for the separation of the metal from animal and vegetable matters; and they are induced to think that its production by the direct agency of hydrochloric acid will be found in practice to be more convenient than by distillation with sulphuric acid and common salt, as recommended by Dr. Fyfe. It appears to be peculiarly suitable for the preparation of the liquid to be subjected to Marsh's process. The chief precaution to be observed is to employ the hydrochloric acid in sufficient quantity and of full strength.

A MARTYR TO SCIENCE.

Dr. Ellenberger, a French physician at Prague, died lately in consequence of an experiment he made on himself with poison, against the effect of which he contended he had discovered an infallible antidote. M. Menière has related, in the *Gazette Medicale*,

some of the experiments of which he was a witness while travelling in Germany with M. Orfila. During their visit to the Museum of Natural History at Prague, they were introduced to Dr. Ellenberger, who was happy at having an opportunity of showing them his experiments with the antidotes against vegetable poisons, and particularly strychnine and morphine. After relating the various trials he had made on himself, he proposed to perform an immediate experiment. He sent to an apothecary for 15 decigrammes (18 grains) of acetate of morphine, which, after it had been examined by M. Orfila and declared to be pure, he put on his tongue and swallowed, to the great alarm of all present. One minute afterwards he swallowed about the same quantity of a white powder, and the poison produced no effect whatever on him. He related that he had made the same experiment on animals and on plants, and invariably with the same result. He appears to have done the same with strychnine, and always with impunity, until the last time, when he unfortunately lost his life.—*Lancet.*

POISONOUS MUSHROOMS.

SOME time since a Belgian physician, M. Girard, created much sensation by partaking and causing his family to partake of Poisonous varieties of Mushrooms in large quantities, without any dangerous result. His safeguard consisted in frequently washing the mushrooms in question with hot vinegar and salt, by which the poisonous principle seemed to be removed. Some doubts have been cast, however, on the truth of the Belgian doctor's inferences by a botanist and a physician of Bordeaux, M. Desmartine and M. Corne, who have proved that a variety of mushroom called poisonous is not necessarily poisonous for every locality—that climate and soil in fact modify the nature of mushrooms to an extraordinary extent. For example, the *amanita rubra* of Lamarck is mentioned by all authors as a violent poison, nevertheless the inhabitants of Bordeaux and its neighbourhood eat this fungus with impunity, submitting it to no further preparation than mere roasting on coals; indeed, this particular kind of mushroom is considered as a luxury in the neighbourhood of Bordeaux. Whilst thus establishing the modifying influence on mushrooms of soil and climate, the Bordeaux physician and botanist prove the safeguard of M. Girard—namely, frequent washing with hot vinegar and salt—to be no safeguard if the mushrooms acted on be really poisonous. For the purpose of demonstrating this, they took a specimen of poisonous *agaricus laccatus,* and macerated it for ten hours in vinegar and salt. They then cooked it, and having administered the cooked results to an animal, death rapidly ensued. There cannot be a doubt, therefore, that it would be highly unsafe to rely on the process recommended by M. Girard.

GUTTA PERCHA.

M. PERROT has submitted to the Paris Academy of Sciences, some specimens of Gutta Percha, which he had purified to such an extent, and manufactured in such thin sheets as enabled him to use it as a

substitute for paper, upon which he had taken impressions from the lithographic stone. One of the advantages which he stated this would possess over the ordinary paper impression was, that of enabling the reverse of any given object to be obtained, without the labour of redrawing it.

CONFECTIONERS' PEAR-DROPS.

THE flavour given to these drops is derived from an alcoholic solution of pure acetate of amyloxide, considerable quantities of which are manufactured by some distillers, (from fifteen to twenty pounds weekly,) and sold to confectioners, who employ it chiefly in flavouring Pear-Drops, which are merely barley-sugar flavoured with this oil. Besides the pear-oil, there is an apple-oil, which, according to analysis, is nothing but valerianate of amyloxide.—*Annals of Pharmacy and Practical Chemistry.*

MINERALOGY OF BELFAST.

THE peculiar geological character of the rocks of the neighbourhood afforded an opportunity (at the late meeting of the British Association) to the chemists of Belfast of adding to our store of Mineralogical knowledge. It appears that the green sand, which is plentifully scattered over the province of Ulster, is filled with nodules, which Professor Hodges showed to contain from thirty to fifty per cent. of phosphate of lime, and he pointed out the valuable application of this to agricultural purposes in the place of bone manure. The President, Dr. Andrews, brought before the Section many results of his microscopic and chemical examination of the basalt, trap, and metamorphic rocks of the north of Ireland. The most curious of his observations related to the occurrence of small crystals of yellow pyrites and of magnetic oxide of iron throughout all these rocks. He extracted the crystals of oxide from the powdered mineral by means of a magnet, and found them accompanied in some instances, especially in the case of the basalt from a hill near Ballymena, by minute quantities of iron in a metallic state; a condition in which iron is scarcely known to exist among natural products, except in aërolites, which cannot be considered as part of the terrestrial globe. In examining many crystals of magnetic oxide, Dr. Andrews never discovered lime as a constituent; but magnesia frequently replaced the protoxide of iron, as in one remarkable specimen from the schist rocks of the Mourne mountains, the analysis of which formed the subject of a distinct communication.—*Literary Gazette,* No. 1860.

CHEMICAL WORKS NEAR BELFAST.

AT the late meeting of the British Association at Belfast, an excursion was made by the principal chemists to the Bleaching works of Fenton and Co. Here they saw the linen steamed in large wooden vats, and alternately immersed in a solution of chloride of lime *mixed with carbonate* of soda and of sulphuric acid. Many

times during this process, the linen is violently beaten about by large wooden arms in a stream of water. The party was then conducted to machines in which the linen is rubbed with a strong soap, then to another by which it is starched, and subsequently to the beetles, where by a long continued thumping the peculiar gloss is imparted to the linen fabric The visitors after this drove to the vitriol works of W. Boyd and Co., where are prepared not only oil of vitriol, but also the carbonate of soda and chloride of lime used in the bleaching process. They were conducted over enormous leaden chambers in which the sulphuric acid is made, to the leaden cisterns where it is concentrated, and the platinum-still in which the evaporation is completed; and then off among the salt and condensed hydrochloric acid, and the coal, chalk, and sulphate of soda waiting to be mixed together to form in the furnaces the "black cake," from which the alkaline carbonate is extracted; and in the midst of all this were retorts for the evolution of chlorine gas, which, passed over lime, forms the bleaching powder. Leaving this, the chemists visited the starch and glue works of Mr. Tucker, where they beheld meal converted into starch, and rough scraps of hides and hoofs into glue and size. Those who wished to see the further progress of the linen manufacture visited the Clonard Print Works, and inspected the various processes by which coloured patterns are impressed on this the staple article of the commerce of Ulster.—*Literary Gazette*, No. 1860.

IRISH BOG BUTTER.

A SPECIMEN has been shown to the British Association, by Mr. J. A. Brazier. The substance bearing this name is found accidentally in the various boggy districts of Ireland, sometimes also in Scotland, and is usually in small kegs. Nothing appears to be known as to what this substance formerly was, or the time of its deposit. The keg, the specimen supplying the material for the experiment, was found in this district (Belfast), and was given to Mr. Brazier by Dr. Andrews for the subject of examination. The kegs in which the butter was found give an example of the most primitive form of construction, and are about one foot in height and ten inches in diameter. Mr. Brazier proceeded to detail the purely scientific results of his experiments on this substance.

FLAX IN IRELAND.

DR. HODGES has read to the British Association a paper "On the Growth and Treatment of the Flax Plant." He traced the use of this plant in Ireland from the earliest period; gave a minute account of a crop grown by himself to illustrate its cultivation; detailed analyses of some proximate constituents; and described the whole process of preparation of the fibre for the spinner. Besides the ordinary methods, he spoke of an entirely new process for removing the epidermis from the real flax (patented by Mr. Watts). It is effected by means of exposing the stalks to the influence of steam confined in

closed chambers and squeezing them between long rollers. This paper was abundantly illustrated by diagrams of apparatus, and samples of the material in every stage, from the plant as taken from the field till it is worked up into fine damask. A brisk discussion followed the reading, in which several manufacturers took an active part; when Claussen's process for converting flax into an imitation of cotton was supported by Dr. Ryan, and freely canvassed by others. The numerous works in Belfast and its vicinity afforded to members of the Association ample opportunity of examining the whole preparation of flax. The plant grows abundantly in the fields. It was being cut down and stacked at the time, and parties of chemists visited Schenk's steeping works, where they saw the flax lying in large vats of heated water undergoing fermentation, by which the outer coating is removed; and as according to Dr. Hodges this is the butyric fermentation, it may be readily imagined that the odour emitted was strong, and anything but agreeable. In the same establishment was seen the process of scutching, by which the central woody matter is broken up and removed. The flax-mills in the neighbourhood exhibited the further process of hackling, by which the fibre is thoroughly cleansed previous to being spun into thread and woven into a variety of textures.—*Literary Gazette*, No. 1861.

STRYCHNINE AND BITTER BEER.

In the course of a Lecture on the subject of Public Health, delivered in March, 1852, at the Conservatoire des Arts et Métiers, in Paris, Professor Payen, referring to the Alkaloid Strychnine, revived an old story, that this substance was manufactured in France, and sent over to England to adulterate bitter beer. Such a statement could hardly have been received, even for a time, in England, were it not notorious that many of our inferior beers are adulterated to a fearful extent. One of the main causes of the greater consumption of bitter beer seemed to be, that there was less opportunity for "doctoring" it than with the sweeter and thicker forms of porter and ale. It was therefore not to be wondered at, that when this announcement of the Professor's was made public in the newspapers, it excited much attention and anxiety. Although there are *à priori* reasons that would have rendered it highly improbable that so powerful a poison as strychnine could be used to adulterate food without detection, the public are indebted to Mr. Allsopp, one of our largest bitter-ale brewers, for furnishing them with the means of detecting any such adulteration, and of so demonstrating that his own beer at least contains none of this deleterious agent. When M. Payen's announcement was made, several of our daily and weekly journals took up the subject; but as time was precious, Mr. Allsopp commissioned Professor Graham, of University College, and Dr. Hofmann, of the Royal College of Chemistry, to report on the subject. The labours of these two distinguished chemists have resulted in the discovery of a test delicate enough to detect the thousandth part of a grain of strychnine, and of a means of separating this agent from any form of beer in which it may be contained. The

mode of detecting the strychnine is, to moisten the powder with a single drop of undiluted sulphuric acid, and then to add a small fragment of chromate of potash. The moment the latter comes in contact with the liquid, a beautiful and most intense violet tint is speedily diffused over the whole liquid, which disappears entirely again in a few minutes. This effect, however, is not produced when organic matter is present,—hence the strychnine must be first separated from the beer, which, if any is present, may be obtained by adding to the beer animal charcoal. This substance takes up the strychnine, which may be afterwards dissolved up by spirits of wine. The solution, on being distilled, leaves the strychnine in a solution of a watery fluid, which is treated with potash, and afterwards with ether. The ether holds in solution the strychnine in a state sufficiently pure to be detected by the test. Although by this process a half grain of strychnine was easily detected in half a gallon of beer, no one of the specimens of beer which were examined by Messrs. Hofmann and Graham—from bond, hotels, and other sources—contained the slightest trace of the deleterious agent. It appears, from inquiries directly put to M. Payen by the English chemists, that he had no other authority for making his statement than that of the late M. Pelletier, a manufacturer of organic products in Paris, who ten or twelve years ago had a large order for strychnine which was sent to England, and which he was informed was employed to complete the bitter of certain kinds of beer. We cannot but think that M. Pelletier was misinformed; and the large quantities sent to England may, we think, be better explained by the fact, that about ten or twelve years ago it was recommended in various diseases by some members of the medical profession, and given more extensively at that time than its virtues have since warranted. Even M. Payen, in the lecture which has excited so much attention, expressed his conviction that the fraud had now ceased.—*Athenæum*, No. 1281.

Prof. Liebig has addressed a letter to Messrs. Allsopp, confirming the excellent Report of Professors Graham and Hofmann, upon the alleged adulteration of pale ale by strychnine, and the very simple process indicated by them for detecting the most minute quantity of strychnine contained in beer. Prof. Liebig has satisfied himself of the great convenience and accuracy of their method, and has further assured himself, by an analysis of several specimens of pale ale obtained from London houses, supplied by Messrs. Allsopp's establishment, of the utter groundlessness of the imputation, that this beer was poisoned with strychnine. "I am positive (adds Prof. Liebig) and am supported in my views by the concordant analyses of all chemists who have occupied themselves with the examination of beer, that the poisoning of pale ale with strychnine has never occurred. I believe I may safely add, that it never will take place; for although an ignorant brewer might be induced from interested motives to add *Nux vomica* to his beer, the word strychnine so *forcibly suggests* one of the most virulent poisons, that whoever has *heard anything* about strychnine at all, is sure to be aware of this.

By adulterating his beer with strychnine, the brewer would be knowingly committing a crime which, in the present state of science, must be followed by immediate detection and punishment.

"Mr. E. Merck of Darmstadt, one of the most extensive strychnine manufacturers in Europe, informs me that this substance is peculiarly adapted to destroy vermin of all kinds. In many parts of Germany it is the popular poison for rats and mice. This fact fully accounts for the large amount of the drug that has lately been introduced into commerce.

"The specimens of your pale ale sent to me have afforded another opportunity of confirming its valuable qualities. I am myself an admirer of this beverage, and my own experience enables me to recommend it, in accordance with the opinion of the most eminent English physicians, as a very agreeable and efficient tonic, and as a general beverage both for the invalid and the robust."

PROGRESS OF PHOTOGRAPHY.

The Calotype Patent Right.—In the morning journals of Aug. 13, appeared two letters, being a correspondence between the Presidents of the Royal Society and Royal Academy and Mr. H. Fox Talbot, which created considerable interest among the lovers of the art of Photography. Observing the rapid advance which, owing to competition, the art of obtaining sun-pictures upon paper is making in France, the representatives of art and science in this country requested the wealthy inventor and patentee to make such alterations in the exercise of his right as may obviate the difficulties which appear to hinder the progress of the art in England. Mr. Fox Talbot, feeling himself unable to pursue the different applications that have opened out in this beautiful art, generously responded to the request by surrendering his patent, and offering it as a free present to the public, in all its branches, excepting that of taking calotype portraits for sale.

The Calotype process was made the subject of a patent in 1841, and on the 10th of June in that year a paper was read before the Royal Society, giving an exact description of the manipulatory processes. This paper was not published, as a law of the Society excludes the publication of all matters which are the subjects of patents. In 1842, Mr. Talbot obtained a second patent for sundry improvements in the calotype, which had reference more particularly to the fixing of the picture. More recently another patent was obtained by Mr. Talbot for photographic pictures on porcelain tablets, and for sundry improvements by Mr. Malone in the use of albumen on paper and glass; and lastly, the same gentleman patented his so-called "Instantaneous process," of which he published an account in 1851. There have been sundry very unpleasant disputes as to the claims of the patentee, but these are now happily ended by the announcement of the resignation of the patent right.

"Photographic portraits for sale" are still reserved by the patentee. This, we understand, has arisen from the difficulty of settling the *amount of compensation* which should be given to those holding

licences from Mr. Talbot for the practice of the art.—*Literary Gazette*, No. 1858.

The Traveller's Camera.—The following interesting letter, which we give in an abridged form, has been addressed by Mr. Fox Talbot, the inventor of the Talbotype process, to the *Literary Gazette:*

Lacock Abbey, Nov. 23.

A friend recently returned from Egypt, Syria, and other parts of the Levant, and who has brought home with him a large collection of photographic views, has written to me respecting the difficulties he had to contend with in those scarcely civilized regions, where he had only a tent—*often only his cloak*—under which to manipulate.

I think, therefore, that I shall perhaps be rendering some service to other wandering photographers by describing the method which I myself employ under similar circumstances.

At first I was accustomed to prepare the paper beforehand, which retained its sensibility during some hours sufficiently well. But this method had, in the first place, the inconvenience of being exposed to occasional failure, which required all the principal points of view to be taken in duplicate as a necessary precaution. And, secondly, it required the use of as many paper-holders as there were prepared sheets of paper; because, on the supposition of the operator being unprovided with a tent, or some substitute for one, and of his not meeting with a shelter of any kind, it was a matter of difficulty to remove the photographic pictures from the paper-holder and place fresh sheets of prepared paper therein, without allowing a gleam of light to fall on them during the exchange. Add to this, that in order to have a reasonable degree of security, that the paper would keep good for twelve or twenty-four hours, it was found advisable to diminish its sensibility, so that it would not work well by an evening or failing light. These inconveniences led me to the invention of a *modus operandi* to which I propose to give the name of the *Traveller's Camera.*

First, I mount the camera itself upon a board of its own breadth, but two or three inches longer than it. I then make a table or support, beneath the surface of which are sunk or concealed three troughs, which are retained in fixed positions. One of these is intended to hold a solution of nitrate of silver; the second, either a solution of gallic acid, or sulphate of iron; and the third, water. The usual paper-holder is dispensed with, but instead of it there is a simple frame, to which a sheet of paper or pane of glass can be attached from behind, and taken away again, while the upper frame remains in the camera. The upper part of the frame carries a long handle, passing through the lid of the camera, which may either stand upright, or, if it be jointed, it can be folded down on the camera. When the camera is placed on its table, or support, it can move upon it in one direction only, backward and forward; being confined to that motion by two parallel strips of wood, upon which are placed certain marks corresponding to a mark upon the camera, indicating that when either of these marks are brought into union, then the paper-holding frame of the camera is in a vertical line over the centre of one of the troughs. When arrived at the scene of action

the *modus operandi* is this: having first filled the troughs with their respective liquids, the camera is placed upon its table or support, and this again upon a stand, which is usually required to give it a due elevation from the ground. The camera is pointed at the object, and a sheet of ground glass is placed in the frame from behind to obtain the focus, and is then removed, and a sheet of prepared iodized paper, or a plate of iodized glass (which of course must not be at all sensitive), is put in its place. A door is then shut at the back of the camera, which places the prepared paper or glass in the dark. The camera is then moved on its support to the mark indicating the trough of nitrate of silver. The object-glass of the camera is then closed. The operator next takes hold of the frame by its handle and pushes it down into the trough below, which he is enabled to do by reason of a narrow slit in the bottom of the camera, which allows a passage. He then draws it up again immediately. He then opens the object-glass of the camera, and after a due time closes it again. He next moves the camera on its support to the mark indicating gallic acid, or sulphate of iron. He then, as before, pushes the frame down and lifts it up again, either immediately or after a due length of time. He then, in a similar way, drops the frame into and out of the trough of water. He next opens the door at the back of the camera, and takes out and examines the picture he has obtained, which for that purpose he may freely expose to the light. If not satisfied with it, he tries again, correcting his process by his first experience. But if he is satisfied with his picture, he deposits it in his box. It is not yet quite finished, but the finishing process is deferred without inconvenience until after his return in the evening. H. Fox Talbot.

Photographic Landscapes on Paper.—Sir John Herschel has communicated to the *Athenæum*, No. 1311, the following application, by his brother-in-law, Mr. John Stewart, resident at Pau, Pyrenees. Sir John Herschel observes, introductorily:—"The extreme simplicity employed by him for the preparation of the paper, its uniformity, and the certainty attained in the production of its results, seem to render it well worthy of being generally known to travellers. The air-pump employed may be one of so simple a construction as to add very little to either the weight, bulk, or expense of the apparatus required for the practice of this art. The obtaining of a *very perfect vacuum* for the imbibition of the paper, being a matter of little moment—a single barrel (worked by a cross handle by direct pull and push), furnished with a flexible connecting-pipe, and constructed so as to be capable of being clamped on the edge of a table, would satisfy every condition."

"Thanks to the valuable indications of Prof. Regnault, of the Institute," says Mr. Stewart, "I have been enabled to produce, what appears to me most satisfactory results in *Photographic Landscapes on Paper.*

"The following observations are confined to negative paper processes, divisible into two—the *wet* and the *dry*. The solutions I employ for both these processes are identical, and are as follow:—

Solution of Iodide of Potassium, of the strength of 5 parts of iodide to 100 of pure water.

Solution of Aceto-Nitrate of Silver, in the following proportions: 15 parts of nitrate of silver; 20 of glacial acetic acid; 150 of distilled water.

Solution of Gallic Acid, for developing, a saturated solution.

Solution of Hyposulphite of Soda; of the strength of 1 part hypo. of soda to from 6 to 8 parts water.

The solutions employed are thus reduced to their simplest possible expression, for it will be observed that in iodizing I employ neither rice-water, sugar of milk, fluorine, cyanure, nor free iodide, &c. &c.; but a simple solution of iodide of potassium (the *strength* of this solution is a question of considerable importance, not yet, I think, sufficiently investigated).

For both the wet and the dry processes I iodize my paper as follows:—In a tray containing the above solution I plunge, one by one, as many sheets of paper (twenty, thirty, fifty, &c.) as are likely to be required for some time. This is done in two or three minutes. I then roll up loosely the whole bundle of sheets, while in the bath; and picking up the roll by the ends, drop it into a cylindrical glass vessel with a foot to it, and pour the solution therein, enough to cover the roll completely (in case it should float up above the surface of the solution, a little piece of glass may be pushed down to rest across the roll of paper and prevent its rising). The vessel with the roll of paper is placed under the receiver of an air-pump and the air exhausted; this is accomplished in a very few minutes, and the paper may then be left five or six minutes in the vacuum. Should the glass be too high (the paper being in large sheets) to be inserted under a pneumatic pump receiver, a stiff lid lined with India-rubber, with a valve in the centre communicating by a tube with a common direct-action air-pump may be employed with equal success. After the paper is thus soaked *in vacuo* it is removed, and the roll dropped back into the tray with the solution, and then sheet by sheet picked off and hung up to dry, when, as with all other iodized paper, it will keep for an indefinite time.

I cannot say that I fully understand the rationale of the action of the air-pump, but several valuable advantages are obtained by its use:—1st. The paper is thoroughly iodised, and with an *equality* throughout that no amount of soaking procures, for no two sheets of paper are alike, or even one, perfect throughout in texture; and air-bulbs are impossible. 2nd. The operation is accomplished in a quarter of an hour, which generally employs one, two, or more hours. 3rd. To this do I chiefly attribute the fact that my paper is never solarized even in the brightest sun; and that it will bear whatever amount of exposure is necessary for the deepest and most impenetrable shadows in the view, without injury to the bright lights.

Wet Process.—To begin with the *wet* process. Having prepared the above solution of aceto-nitrate of silver, float a sheet of the iodized paper upon the surface of this sensitive bath, leaving it there for about ten minutes. During this interval, having placed the glass or slate of your slider quite level, dip a sheet of *thick* clean white printing (unsized) paper in water, and lay it on the glass or slate as a wet lining to receive the sensitive sheet. An expert manipulator may then, removing the sensitive sheet from the bath, extend it (sensitive side uppermost) on this wet paper lining, without allowing any air globules to intervene. But it is difficult, and a very simple and most effectual mode of avoiding air-globules, particularly in handling very large sheets, is as follows: Pour a thin layer of water (just sufficient not to flow over the sides) upon the lining paper, after you have extended it on your glass or slate, and then lay down your sensitive paper gently and by degrees, and floating as it were on this layer of water; and when extended, taking the glass and papers between the finger and thumb, by an upper corner, to prevent their slipping, tilt it gently to allow the interposed water to flow off by the bottom, which will leave the two sheets of paper adhering perfectly and closely, without the slightest chance of air-bubbles; it may then be left for a minute or two, standing upright in the same position, to allow every drop of water to escape; so that when laid flat again or placed in the slider none may return back and stain the paper. Of course, the sensitive side of the sheet is thus left exposed to the uninterrupted action of the lens, no protecting plate of glass being interposed,—and even in this dry and warm climate I find the humidity and the attendant sensitiveness fully preserved for a couple of hours.

To develope views thus taken, the ordinary saturated solution of gallic acid is

employed, never requiring the addition of nitrate of silver; thus preserving the perfect purity and varied modulation of the tints. The fixing is accomplished as usual with hyposulphite of soda, and the negative finally waxed.

Dry Process.—In preparing sheets for use when *dry* for travelling, &c., I have discarded the use of *previously waxed* paper,—thus getting rid of a troublesome operation,—and proceed as follows: Taking a sheet of my iodized paper, in place of floating it (as for the wet process) on the sensitive bath, I plunge it fairly into the bath, where it is left to soak for five or six minutes—then removing it, wash it for about twenty minutes, in a bath or even two of distilled water, to remove the excess of nitrate of silver, and then hang it up to dry (in lieu of drying it with blotting paper).—Paper thus prepared possesses a greater degree of sensitiveness than waxed paper, and preserves its sensitiveness not so long as waxed paper, but sufficiently long for all practical purposes, say thirty hours, and even more. The English manufactured paper is far superior for this purpose to the French. To develope these views, a few drops of the solution of nitrate of silver are required in the gallic acid bath. They are then finally fixed and waxed as usual.

These processes appear to me to be reduced to nearly as great a degree of simplicity as possible. I am never troubled with stains or spots, and there is a regularity and certainty in the results that are very satisfactory. You will have observed, too, how perfectly the aërial perspective and gradation of tints are preserved—as also how well the deepest shadows are penetrated and developed—speaking, in fact, as they do, to the eye itself in nature. In exposing for landscape, I throw aside all consideration of the bright lights, and limit the time with reference entirely to the dark and feebly-lighted parts of the view; with a 3½-inch lens, the time of exposure has thus varied from ten minutes to an hour and a half, and the action appears to me never to have ceased.

The influence of the air-pump in this appears to me very sensible, and deserving of further examination and extension. I purpose not only iodizing, but rendering the paper sensitive with the action of the air-pump, by perhaps suspending the sheet after immersion in the nitrate bath under the receiver of the air-pump for a few minutes, before exposure in the camera, or by some other manœuvre having the same object in view.

I should add, that I have chiefly employed Canson's French paper in iodizing with the aid of the pump. Few of the English manufactured papers are sufficiently tenacious in their sizing to resist the action of the pump, but they may easily be made so; and were, in short, the English paper so far superior in quality to the French, only better sized, that is, with glue less easily soluble, even though more *impure*, there is scarcely any limit to the beauty of the views that might be produced.

There are more minor details that might be given; but I fear repeating many a "twice-told tale," acquainted so little as I am with what is doing;—the preceding, however, may have some interest; and whatever is of value is entirely due to our friend M. Regnault, ever so generously ready as well as able to aid and encourage one's efforts.—JOHN STEWART.

Iodide of Ammonium.—Mr. I. B. Hockin has addressed to the *Athenæum* a letter, recommending the substitution of the Iodide of Ammonium for the iodide of potassium in the Collodion process. Mr. Hockin is anticipated by M. Adolphe Martin, who, in the *Comptes Rendus* of July 5, recommends the use of that salt. M. Martin also converts the negative collodion picture into a positive one, by plunging it, after it has been developed with the protosulphate of iron, into a bath of the double cyanide of silver and potash, made in the proportions of 60 grains of nitrate of silver and 375 grains of the cyanide of potassium in about two quarts of water. On the use of the iodide of ammonium Mr. Hockin remarks:—"It possesses many collateral advantages. The double iodide of silver and ammonium dissolves to almost any amount and with great facility in the collodion, and does not deposit a portion of its silver,

like the corresponding potash compound. Consequently, the collodion may be iodized and used within an hour. It does not so greatly impair the tenacity of the resulting film; nor does it tend to *thin* the collodion to so great an extent; nor does the mixture become discoloured by any means as rapidly. I have kept a quantity at a heat of 70° F. during a fortnight without producing any change in its appearance, the bottle being not full and frequently opened. By the addition of from ten to twenty drops of a saturated solution of the above-mentioned double iodide in alcohol to each ounce of collodion, I have procured good positive pictures of buildings in a fraction of a second, and a negative portrait in one second, without otherwise departing from the usual process."

Beauford's "Accelerators."—Mr. Beauford, of Hastings, has registered the following invention, which, by being applied to the usual Daguerréotype instrument, materially increases its power and capabilities in a variety of ways.

It is thus described in the *Mechanics' Magazine:* The object-glass used on this occasion was one of Voigtlander's double achromatic daguerreotype lenses, with a diameter of 3⅛ inches. We took our seat about 6 feet from this instrument, and our portrait was taken in 40 seconds, the operation in this case being unassisted by any additional apparatus. The next step was to apply one of Mr. Beauford's "accelerators" to the instrument, when a portrait was obtained in the space of 25 seconds, the instrument and ourself remaining unmoved. This accelerator was next removed and another substituted, when the time was shortened to 15 seconds. A third step was made, and the accelerator on this occasion did its work in less than 10 seconds. As the accelerator increased in power, the portraits diminished in size, but the life-like appearance of the portraits thus obtained was very striking, the picture appearing in high relief, devoid of the flat appearance observable in daguerreotype portraits taken in the usual way.

We may here remark, that the portraits thus taken were obtained while the room was shaded with a thick cloth, or the time of operation would have been still further abbreviated. On a subsequent occasion the cloth was removed, and the result was, that the photographs were obtained in one-third the time required on the previous occasion; for instance, a portrait which required 15 seconds on the previous day, only took five seconds on this, so that a portrait which occupied 10 seconds before, now only required about three seconds.

Thus from the same instrument, without any change of position beyond a little screwing of the moveable parts of the camera, we had four different portraits taken, varying from a considerable size down to a much smaller one. Had not the accelerator been employed, a change of instrument must have taken place, or else a change of position, which process would have required more space than most studios would permit, to say nothing of other inconveniences. From our own observations we can state of Mr. Beauford's invention, that it is eminently qualified to cheapen and facilitate photo-

graphic operations. Instead of having four costly instruments of various sizes, the operator need have but one large one, as by employing different accelerators (which are very much cheaper than an entire instrument) he can obtain portraits of any degree of diminution. He also avoids all trouble of moving his apparatus about to catch the required foci for portraits of different magnitudes. He will likewise find the accelerator so to intensify the solar influence, that by its aid he will be able to take portraits in dull weather which would defeat his best efforts with the ordinary instrument.

Photographers will understand us when we tell them that no diaphragms are employed in this process. Respecting these appliances we could call the attention of artists to the fact, that a diaphragm diminishes the amount of solar radiation which enters the camera, and therefore weakens the power; whereas the accelerator, while it diminishes the size of the portrait, increases the strength of the actinic influence, and abbreviates the time of the operation while it improves the result.

It has long been an objection to photographic portraits that they are distorted, the central and forward parts being disproportionately large. This is generally observable in the case of the hands, which appear of a size not very agreeable to any one of the gentler sex who may have been the sitter on the occasion. By employing Mr. Beauford's accelerator this is entirely obviated, and the representation is in all respects a faithful one.

In the ordinary process, when an operator requires a smaller portrait he has to draw his instrument further back, in doing which he loses power, his lenses receiving a lesser amount of radiation from the object. By using the accelerator, he is enabled to maintain his former position, and hence avoids a loss of power. As we have said before, no distortion arises from this process.

Negative Photographic Paper.—M. Gustave Legray has communicated to the *Moniteur Industriel* (translated in the *Mechanic's Magazine,*) the use of a size adapted to any kind of paper. The substance used for this size is virgin wax, which is kept at a temperature of 100° centigrade, in a large flat vessel, and the paper is immersed therein until completely saturated with the wax. The sheet of paper is then withdrawn, and laid between several pieces of blotting paper, over which a moderately heated iron is passed, which causes the blotting-paper to absorb the superfluous wax. If the paper is properly prepared, there will be no gloss whatever on its surface, and it will be perfectly transparent. The waxed paper is then immersed in a warm solution composed as follows:

1000 parts of rice water. 40 parts of sugar of milk; 15 do. of iodide of potassium; 0.80 do. cyanide of potassium; 0·50 do. fluoride of potassium. The sheet of paper should be laid in this solution for half an hour, and it may then be withdrawn and hung up to dry. The paper is then immersed in a clear solution of aceto-nitrate of silver, which is thus formed:—300 parts distilled water; 20 do. azotate of silver; 24 do. crystallizable acetic acid; 5 do. animal char-

coal. The animal charcoal serves to render the paper more susceptible to receive impressions, and decolorizes the solutions when they have been previously used. The paper should remain three minutes in this solution, and in order to insure contact with the liquid, the two sides of the sheet should be rubbed over with a brush. The paper is then washed several times with distilled water, and well-dried between pieces of blotting-paper. Paper thus prepared may be taken immediately into the dark chamber, and it is not necessary to subject the image to the action of gallic acid on its removal from the camera: this may be deferred till the evening, or even the next day, or the day following. The paper may be kept in a dark place for more than a fortnight without undergoing any alteration, and in this respect offers greater advantages than any of the photographic papers hitherto known. The solution of gallic acid is composed of 1 part of gallic acid, half part (0·5) of azotate of silver, and 200 parts of distilled water. The image is fixed as usual by hydrosulphite of soda. This process, M. Legray states, is so easily put in practice that by it he has often taken from 25 to 30 photographs a day.

THE HILLOTYPE.

A LETTER from New York in the *Glasgow Herald* announces "a new process of 'Daguerreotyping,' discovered by Mr. L. L. Hill, of Westkill, State of New York, whereby is obtained, upon the Daguerreotype plate, portraits from life, landscape views, &c. &c., all in the most brilliant perfection of nature's own form and colouring. . . . I cannot better describe these pictures, than by comparing them to the rich enamelled surfaces of some of the finest porcelain; owing to this characteristic, the Hillotypes have a surprising *relief* and atmospheric appearance, much resembling in reality the illusions of the 'Stereoscope.' The hardness and imperishable character of these pictures may be judged of from the fact, that they are finished by long-continued buffing—in other words, the silver plate having upon it the Hillotype picture, is subjected to very hard rubbing with buff leather, stretched upon a narrow board, and it is passing strange what an improvement this effects upon the first result, as it issues from the developer. The theory of the process is charmingly simple, and beautifully compatible with the admitted philosophy of colours. No colouring matter is conveyed to these plates, but the hues they take on are owing to molecular arrangement, each ray of the spectrum acting with its own intensity and in its own peculiar mode in breaking up and changing the form of the sensitive surface. The action once commenced, in ever so slight a degree, is carried on, not by the use of colouring matter, but by way of a continued decomposition produced by a change of the means—substituting chemical agency for actinism. The process is an exceedingly quick one, portraits are produced by it in diffused light, in the short space of from one to ten seconds; landscapes, in the fraction of a second. This will be a vast advantage in the practical working of the process, there appearing no reason to doubt that not only may nature be copied in its

quiet stillness, but in motion. It will be applied to ornithology, botany, morbid anatomy, and to various other purposes."

MICROSCOPIC PHOTOGRAPHS.

MR. E. W. DALLAS, Royal Institution, Edinburgh, has observed in the *Athenæum*, No. 1282, that "the collodion process on glass offers peculiar facilities for working with the microscope; but as the accumulation of the plates is highly inconvenient, it appeared desirable that some method should be devised for the preservation of the picture without the glass. This may be effected by transferring it to a piece of waxed paper, which forms a most excellent substitute. The process is very easy. The picture having been obtained, the film of collodion is floated off the glass under water, and removed to a bath of isinglass so weak as to be fluid when cold; in this bath the waxed paper having been previously soaked for a few minutes, the arrangement and extension of the pellicle is effected by gently moving it with the fingers, and then carefully raising up both it and the paper together, holding them so as to let the water run from between them. It is necessary to hold both, for the film slips about very easily. Blotting paper will then absorb some of the superfluous water, and the remainder may be forced out by rubbing slightly, but always in one direction. By drying the whole under pressure the picture will be found firmly adherent to the paper. I am far from offering the specimens sent as perfect examples of what may be effected by the aid of the microscope,—but shall be glad to know whether the transfer of the film of collodion from the glass plate to the waxed paper may be considered an improvement, as it would certainly seem to offer some advantages. I may observe with respect to the production of images of transparent objects, that there may be some doubt whether in all cases the photographic picture is true:—for the light being decomposed in its passage through them, will, of course, affect the faithfulness of the image.

I am, &c.,

E. W. DALLAS.

*** Mr. Archer has been in the habit of separating the film of collodion from the glass and transferring it to paper; but it appears to us that there are some valuable suggestions in our Correspondent's note.—ED. *Athenæum*.

FIXATION OF COLOURS.

M. NIEPCE DE SAINT-VICTOR has laid before the Paris Academy of Sciences, Daguerreotypes upon which he had succeeded in fixing, in a manner more or less permanent, colours by the camera obscura. M. Niepce states, that the production of all the colours is practicable, and he is actively engaged in endeavouring to arrive at a convenient method of preparing the plates. "I have begun," he says, "by reproducing in the dark chamber coloured engravings, then artificial and natural flowers, and lastly dead nature—a doll, dressed in stuffs of different colours, and always with gold and silver lace. I have *obtained all the colours;* and, what is still more extraordinary and

more curious is, that the gold and the silver are depicted with their metallic lustre, and that rock-crystal, alabaster, and porcelain, are represented with the lustre which is natural to them. In producing the images of precious stones and of glass we observe a curious peculiarity. We have placed before the lens a deep green, which has given a yellow image instead of a green one; whilst a clear green glass placed by the side of the other is perfectly reproduced in colour." The greatest difficulty is that of obtaining many colours at a time; it is, however, possible, and M. Niepce has frequently obtained this result. He has observed, that bright colours are produced much more vividly and much quicker than dark colours:—that is to say, that the nearer the colours approach to white the more easily are they produced, and the more closely they approach to black the greater is the difficulty of reproducing them. Of all others, the most difficult to be obtained is the deep green of leaves; the light green leaves are, however, reproduced very easily. After sundry other remarks, of no peculiar moment, M. Niepce de Saint-Victor informs us, that the colours are rendered very much more vivid by the action of ammonia, and at the same time this volatile alkali appears to fix the colours with much permanence. These results bring much more near than hitherto the desideratum of producing photographs in their natural colours. The results are produced upon plates of silver which have been acted upon by chloride of copper, or some other combination of chlorine. The manipulatory details we understand are very easy.—*Athenæum*, No. 1308.

EXHIBITION OF PHOTOGRAPHY.

On Dec. 22, at the Society of Arts, a very remarkable exhibition of Photography included 774 specimens, the results of the several processes known as Talbotype or Calotype; Waxed Paper; Albumenized Paper; Albumenized Glass; and Collodion. They were contributed by French, German, and English Photographers. The examples dated from the year 1840 to the close of 1852; and thus furnished an illustrated record of the art which they represented from its very commencement.—First in order of date was a curious collection of Photographs from ferns, grasses, and flowers, contributed by Capt. Ibbotson, and entitled 'Le premier Livre imprimé par le Soleil—L. L. Boscawen Ibbotson, Esq., 1840.' The title is borne out by the fact, that the title-page itself, as well as the preface, is sun-printed.—Mr. Fox Talbot exhibited a very interesting book containing specimens of his productions from 1841 to 1846 inclusive. In this there are specimens of the application of the art to objects of almost every class; and although many of them are imperfect, there are some which may be compared without disadvantage with the best of recent specimens. Capt. Ibbotson, in his Preface, refers to the experiments of Prof. Gerber of Berne—who, it is said, had for many years been endeavouring in vain to find some mode of rendering permanent the pictures which it was known to chemists that the sun was capable of producing. Mr. Fox Talbot's first communication to *the Royal Society* on the subject was in 1839.

Looking to the importance of the specimens to Art as well as to their general excellence, we find several features of the exhibition deserving of especial notice. The value of photography as a means of collecting truthful examples of architectural details—especially in the case of the florid ornaments of the ecclesiastical and other edifices of foreign countries, and indeed of our own also,—which could be transferred to paper only by first-rate draftsmen, and at a great expenditure of time—was admirably illustrated by this collection. We saw there specimens of the most beautiful and fantastic carving in stone transferred to paper with undoubted accuracy,—and in many instances with the most delightful artistic effect. Very many examples were marred, it must be admitted, by the intensity of the shadows, which completely hid that part of the work upon which they fell. This seems to arise from there having been too strong a light on the building at the time of taking the photograph. In the case of works in low relief the amount of sunshine would be of less importance;—but where the surface exhibits great inequalities, such deep shadows are ruinous to the effect of the picture. This fault is, however, by no means universal; and many examples prove that it does not appertain to any of the *modes*, but is accidental. There was a large number of architectural specimens, including several interiors, which are very difficult to obtain. There were some beautiful pictures of the ruins of Nubia, Syria, and Upper Egypt, by M. Du Camp, forming part of a serial work published in Paris. The details of these remains are given with great beauty. M. Bretach's views of the city of Vienna exhibited great mastery in the manipulation of the art, and are stated to be the largest photographs ever executed. The smaller landscapes, rustic scenes, and masses of trees, exhibited very satisfactory progress in tone and aerial effects: some of the trees were admirably rendered. There was a considerable number of portraits in different styles; many very clever productions. Besides a large number of specimens from the Great Exhibition, the collection included a number of photographs of the old and also of the new Crystal Palace, by M. De la Motte, with whom, and Mr. Cundall, the idea of such an exhibition originated; and these gentlemen, together with Mr. Fenton, who read a paper on the subject at the opening *soirée*, gave great assistance to the Council of the Society of Arts in the execution of the project. There was one omission of some importance—namely, the exhibition of the various stages, and as far as possible of the several processes, side by side. *Selected and abridged from the Athenæum*, No. 1314.

THE MICROSCOPE AND THE DAGUERREOTYPE.

A PAPER has been read to the Microscopical Society by Mr. Hodgson, "On the Reproduction and Delineation of Microscopic Forms." The author went into the history of the attempts made to delineate microscopic objects by means of the Daguerréotype and Talbotype. He referred more especially to the labours of Dormè, *Claudet, Carpenter,* and Kingsley. He stated his conviction that till

we could engrave from Daguerrèotype plates, photography would be of little service to the microscopist, and recommended sketches from the camera lucida, as much superior for the delineation of microscopic objects. Mr. Delarue stated that he could not agree with the author as to his estimate of the value of photography to the microscopist. So highly did he think of it, that he had recommended the Council of the Society of Arts to present Mr. Delves with a medal, for the series of representations which he had exhibited at the last meeting of the Microscopical Society. Mr. Shadbolt believed that photography would be of great service in delineating microscopic objects,—and exhibited a very beautiful representation of the bee's tongue, which he had succeeded in producing upon a surface of collodion. Mr. Bowerbank saw no reason why we should not be able to print from photographic negatives with as much ease as we now print from a drawing on steel or on stone. Mr. Hogg stated, that he should long since have published such plates, but for Mr. Fox Talbot's patent:—as that gentleman had now presented his patent to the public, such plates would not be long in making their appearance. Mr. Varley pointed out some optical difficulties in presenting thick objects upon a flat surface by means of photography,—and recommended a greater focal length for the object-glass, and a wider aperture. The Chairman stated, that he believed all the optical difficulties might be easily removed.

CHEMICO-GEOLOGICAL RESEARCHES ON THE SULPHURETS WHICH ARE DECOMPOSABLE BY WATER.—BY E. FREMY.

THE object of this paper, says the *Comptes Rendus* for July 5, 1852, is to make known the production and principal properties of a class of sulphurets, hitherto little examined; and the study of which is alike interesting to chemists and geologists, from the light which it throws on the formation of mineral waters.

"When we consider (says Mr. Fremy,) the action of water on the sulphurets, we find that these compounds may be divided into three classes: the first comprises the sulphurets of the alkalies and of the alkaline earths which dissolve in water; the second is formed of the insoluble sulphurets; the third consists of the sulphurets of boron, silicon, magnesium, and aluminum, which are decomposed by water; these latter are scarcely known, owing to their preparation having hitherto been accompanied with great difficulties. In order to a thorough investigation of all the questions which are connected with the decomposition of the sulphurets by water, I first sought for a method by which, they might be easily prepared. This method I will now describe.

"It is well known that sulphur exerts no action upon silica, boracic acid, magnesia, and alumina. I imagined it might be possible to replace the oxygen in these substances by sulphur, by the intervention of a second affinity, as that of carbon for oxygen. Such decompositions, produced by two affinities, are not rare in chemistry; and in some yet unpublished experiments on the fluorides, I had observed that the sulphuret of carbon completely decomposed the

fluoride of calcium mixed with silica, producing sulphuret of calcium. I was therefore led to presume that the sulphuret of carbon, acting by its two elements upon the preceding oxides, would remove the oxygen, by means of the carbon which it contains, and would, at the same time, form sulphurets; this supposition I found confirmed by experiment. In fact, I have obtained the sulphurets of boron, silicon, magnesium, and aluminum, by submitting boracic acid, silica, magnesia, and alumina, to the action of sulphuret of carbon at a high temperature. To facilitate the reaction, and remove the sulphuret from the decomposing action of the alkalies contained in the porcelain tubes, it is sometimes useful to mix the oxides to be reduced with charcoal, and to form them into little balls similar to those which are used in the preparation of the chloride of silicon.

"I have ascertained by analysis that these sulphurets correspond to the oxides from which they have been derived.

"I will now say a few words on the sulphurets obtained by the above method. The sulphuret of silicon had been obtained in small quantity by Berzelius in the reaction of sulphur upon silicon, and by M. Pierre in the decomposition of chloride of silicon by hydrosulphuric acid. I have obtained this substance with the greatest ease, by passing the vapour of sulphuret of carbon over pellets of charcoal and gelatinous silica, placed in a porcelain tube heated to bright red. The sulphuret of silicon condenses in the tube in beautiful white silky needles, which are not very volatile, but are readily carried along by the vapour.

"To show the interest which attaches to the examination of this substance, it will suffice to mention here two of its reactions. When sulphuret of silicon is heated in a current of moist air, it is decomposed, and furnishes silky crystals of anhydrous silica; it is evident that we may explain, by means of this experiment, the natural production of certain filamentous crystals of silica. The sulphuret of silicon in the presence of water is decomposed with a brisk evolution of hydrosulphuric acid into silica, which remains entirely dissolved in the water, and is not deposited until the liquid is evaporated. It is impossible not to connect this curious property with those natural conditions under which certain mineral waters and siliceous incrustations are formed.

"As the sulphuret of silicon is probably produced in all those cases where silica is submitted to the double action of a binary compound which cedes sulphur to it, and at the same time appropriates its oxygen, this sulphuret is probably not so rare as has been hitherto thought; and, by admitting its presence in those rocks in which sulphurous springs occur, we might explain the simultaneous existence of silica and sulphuretted hydrogen in the principal sulphurous waters. This hypothesis is in some measure confirmed by the interesting observations of M. Descloizeaux, which show that the siliceous springs of the Geysers of Iceland contain a large quantity of sulphuretted hydrogen.

"I *content myself* with submitting these considerations to geolo-

gists, merely observing that in explaining the formation of sulphurous and siliceous waters by the decomposition of the sulphuret of silicon, I am only extending the ingenious theory proposed by M. Dumas to explain the formation of boracic acid.

"The sulphurets of boron and aluminum were prepared like the sulphuret of silicon, and are likewise decomposed by water.

"The sulphuret of magnesium I obtained by passing sulphuret of carbon over pure magnesia; in this case the presence of charcoal does not appear to be of any use. This sulphuret crystallizes, and is soluble in cold water. When its solution is kept at the ordinary temperature, there is but a feeble disengagement of sulphuretted hydrogen; but when heated to ebullition, a lively effervesence of sulphuretted hydrogen takes place, and there is an immediate deposition of magnesia."—*Jameson's Journal*, No. 106.

DETECTION OF MORPHINE.

PROF. ABBENE, has detailed to the Medico-Surgical Academy of Turin, certain experiments on animal substances in a state of putrefaction, whence he has obtained a peculiar substance, which, when treated with nitric acid turns red, and with iodic acid, yellow, which latter colour is turned to azure by the addition of starch. The learned professor observed that precisely the same properties were known to belong to Morphine; showing how important it was for a practitioner, in the investigation of criminal cases, not to be over-hasty in declaring the existence of morphine in a dead body. He further showed that the new substance alluded to having no other chemical properties in common with morphine, it was easily distinguishable from the latter.

LIGHT FROM HEATED SUBSTANCES.

PROF. SCHRÖTTER has made to the German Association for the Advancement of Science, some observations on the cause of the Light produced in several Substances when heated, noticing amongst other things, that the light of phosphorus is not owing to evaporation, but is caused by oxidation, and stated that sulphur, selenium, tellurium, and arsenic, at a certain temperature, and under oxidizing influences, begin to give out light, producing states of oxidation different from those caused by ordinary burning.—*Literary Gazette*, No. 1865.

NEW AND STALE BREAD.

M. BOUSSINGAULT, from a variety of experiments, concludes that it is not by a less proportion of water, as generally supposed, that Stale Bread differs from New Bread; but by a peculiar molecular state, which is manifested during the cooling, becomes developed afterwards, and continues as long as the temperature does not exceed a certain limit.

Natural History.

ZOOLOGY.

DISTRIBUTION OF ANIMALS.

There has been read to the British Association a paper "On the Geographical Distribution of Animals in connexion with the Progress of Human Civilization," by W. Ogilby, Esq. The author treated his subject in a very popular manner, and pointed to the less civilized nations of the world, as being so from the absence of animals capable of domestication. America and Australia were the great types of this deficiency. The following conclusion of his paper will give an idea of the general argument and style. "Let us now examine the facilities which the natives of Europe, Asia, and Africa possessed for developing civilization compared with those of America and Australia. The former had those great *collaborateurs* in their social progress, they had the horse, the ass, and the camel, for beasts of burden; and they had the sheep, the ox, and the goat, for food and a thousand other useful purposes. The consequence of this was, that, at a very early period—at a period of which there are few authentic historical documents extant—the nations of Western Asia had advanced in civilization to an extent which is now only beginning to be thoroughly understood and appreciated. The researches of such eminent men as Dr. Layard into the antiquity of Assyria and Egypt, prove this beyond question, and show that those nations had advanced to a power which, in modern times, has scarcely been equalled, and that we are only now in the same state with regard to civilization that they were three or four thousand years ago, whilst the less fortunate inhabitants of America and Australia would be obliged, by the want of those facilities possessed by the former, to remain in their original condition for eternity."

Prince Canino said, that there were some points on which he coincided with the author, but there were others also on which he differed. He did not consider that it was the animals who were to be blamed for the backward state of the aborigines of America and New Holland, but the people themselves. As a beast of burthen, he thought the American bison might be tamed, and made to serve that purpose as well as the ox, for it was a stronger animal, and possessed many useful qualities which the ox did not. As another example of what the people of those countries might do in this way, he would refer to the American grapes, which at one time were thought so useless that there was a proverb to that effect; but now it was found that a good wine can be made from them. In confirmation of Mr. Ogilby's *opinions* as to the origin of domestic animals, he

might say that the prototype of the common cat was that kept in the temples of Egypt.

DISTRIBUTION OF MARINE ANIMALS.

PROF. E. FORBES has explained to the British Association his new map of the Geological Distribution of Marine Life, and on the Homoiozoic Belts. On this map the provinces under which animals and vegetables are assembled, are delineated so as to show their peculiarities, relations, and contrasts. The character of each is marked by the entire assemblage of organized beings constituting its population; a considerable portion in most cases being peculiar, and a still larger number of species having their areas of maximum development within it. The several provinces vary greatly in extent, some being very small, and some very large. But though not equally important in a geographical point of view, their inequality of extension is not opposed to their being of equal natural history importance. The author showed that the northern and southern limits of each province correspond with the boundaries of a latitudinal belt to which, on account of the similarity of organic features presented throughout its extension, the name of *Homoiozoic* is proposed to be applied. Nine of these belts are distinguished; of which one is unique, central, and equatorial, and four in the northern hemisphere represent as many in the southern. The boundaries of the belts on land appear to correspond with the isotherm of the months in which there is the greatest vivacity of animal and vegetable life. The homoiozoic belts are not of equal breadth in all parts; and whilst the Polar belts include only a single province in each, the others severally include many provinces. On the same map, the comparative distribution of marine life in zones of depth in different and distant regions is also laid down,—and a nomenclature applicable to all seas is proposed for them.—*Athenæum*: No. 1299.

In the *Literary Gazette*, No. 1861, the above is characterized as "the most important and novel communication which was made to the Section, that which combined the most elaborate research into details with the broadest generalization, and which must be considered to be the first attempt to reduce all the facts of the distribution of living creatures upon the surface of the earth to general laws." Two modes of classifying facts of distribution have been hitherto adopted; either the geographical areas to which peculiar assemblages of animals and plants are confined have been marked out as "provinces," the classification in this case being natural, but purely biological; or certain parallels of latitude, or certain isothermals, being taken as boundary lines, animals and plants have been considered to be distributed according to the "zones" thus marked out,—a convenient, but hitherto an artificial arrangement, though, since the distribution of life must greatly depend upon the climatal conditions indicated by latitudinal and isothermal lines, it had a certain broad and loose correspondence with nature.

"The great problem has been to unite these two methods, to ascertain what is the common condition by which the limits both of

the 'provinces' and the 'zones' are governed; for since the distribution of life in provinces is governed by climatal conditions, and since the climatal phenomena of any one portion of the earth's surface are continuous (approximatively) in a zone round its surface, it is clear that there must be some such general agreement."

"The provinces were also defined by the learned Professor, but we can here merely enumerate them. They are 25 in number:—1. Arctic; 2. Boreal; 3. Celtic; 4. Lusitanian; 5. Mediterranean; 6. West African; 7. South African; 8. Indo-Pacific; 9. Australian; 10. Japonian; 11. Mantchourian; 12. Ochotyian; 13. Sitchian; 14. Oregonian; 15. Californian; 16. Panamian; 17. Peruvian; 18. Araucanian; 19. Fuegian; 20. Antarctic; 21. East Patagonian; 22. Urugavian; 23. Caribbean; 24. Carolinian; 25. Virginian. Full reference was made to the authorities from whom the data for the establishment of these provinces were taken.

"The Professor further laid before the Section a new nomenclature and re-arrangement of the facts ascertained with regard to the distribution of marine creatures in depth. He now divides the regions of depth into five bathymetrical zones—1. The littoral zone, characterized by *Littorinæ* and *Purpuræ*, and occupying the whole space between high and low water marks. In the Celtic province, this zone is clearly divided into four sub-regions. 2. The circumlittoral zone, between low-water mark and a depth of about fifteen fathoms. It is the zone of *Laminariæ* in the Northern Atlantic, of *Zostera* and *Caulerpa* in the Mediterranean, and of the reef-building corals in the Indo-Pacific province. 3. The median zone, between fifteen fathoms and fifty. This is the coralline zone of the Celtic seas. 4. The infra-median zone ranges from fifty fathoms to a hundred. It is the region of the deep-sea corals in the Celtic seas, and of the red coral of the Mediterranean. 5. The abyssal zone extends from one hundred fathoms downwards. It contains no plants, and animal life seems gradually to disappear in it. In the Celtic seas the region has not yet been properly explored. As a general law it may be said, that as we descend in the sea this region of depth becomes of greater extent, and the range of species is greater."

CIRCULATION OF THE BLOOD.

THERE has been read to the British Association, a paper "On the Forces by which the Circulation of the Blood is carried on," by Mr. Wharton Jones; containing a physiological discovery of very great importance, which was laid before the Royal Society by its author some time ago. In the wing of the Bat, the main impulse to the circulating fluid is, as in other animals, given by the heart; but in addition, Mr. Jones has discovered that the walls of the veins in this animal contract rhythmically like those of the heart, and any regurgitation being prevented by numerous and appropriately placed valves, they thus assist very materially in forcing the blood onwards. The existence of this rhythmical contractility in the walls of the veins is a fact new to physiological science.—*Literary Gazette*, No. 1861.

NATURAL HISTORY IN NORWAY.

A CORRESPONDENT of the *Athenæum*, No. 1267, gives the following statement of the number of birds and beasts of prey for the destruction of which Government premiums were paid in five recent years:

	Bears.	Wolves.	Lynxes.	Gluttons.	Eagles.	Mountain Owls.	Falcons and Hawks.
1846	219	238	104	81	1055	154	249
1847	270	259	116	88	2594	484	480
1848	264	247	144	51	2498	369	527
1849	325	197	110	76	2142	343	485
1850	246	191	118	39	2426	268	407

SKULLS OF "THE BISON."

Mr. D. W. MITCHELL, the Secretary, has exhibited to the Zoological Society a series of Skulls of the Gouwa, (*Bos frontalis*,) commonly called the "Bison" by the English in India. These skulls had been presented to the Society by Capt. Wycliffe Thompson, 10th Royal Hussars, who had himself collected them in the Western Ghauts, or Sukyadri mountains, expressly for this purpose. The skulls represent an adult bull, cow, and a younger animal. They formed the subject of a very interesting communication, addressed by Captain Thompson to the Secretary, in which he narrated the result of his hunting reminiscences, while in pursuit of several herds, in the hope of obtaining a pair of living calves, which he had, at the request of Colonel Perronet Thompson, been desirous of capturing and adding as a gift to the Society's collection. The range of the Gouwa appears to be exclusively confined to the Western Ghauts—a narrow belt of wild, broken, and thickly-wooded country, dividing the highlands of the Deccan from the lowlands which border the margin of the sea. The Gouwa attains an enormous size, old bulls being currently estimated as measuring nineteen hands at the shoulder, with a corresponding weight, notwithstanding which they crash through the jungle, when fairly alarmed, at a very rapid pace, making their progress visible by a long track of waving branches tossing above them like the wake of a ship at sea.

THE LEUCORYX.

AMONG the most recent additions to the Menagerie of the Zoological Society, is a young Leucoryx, the first of her race that has been born out of Africa. The delicate colouring, the long exquisitely-curved horns, and the noble carriage of the Leucoryx, stamp it at once as one of the gems of the collection; and, in fact, the animals in question are the only specimens of their kind in Europe. The male was obtained by the late Lord Derby from the Gambia,

the mother came from Nubia; and the species may, therefore, be taken to inhabit, like many others which are common to the western and eastern coasts, the whole extent of the Negro zone in Africa. It occurs in the ancient monuments of Egypt, as forming part of the tribute paid to the kings by Ethiopia; and it, therefore, in addition to its natural beauty, has a peculiar historic interest, which must be appreciated by every one who is familiar with the ancient legends of the Valley of the Nile.

THE CHOIROPOTAMUS.

THE Zoological Society have some time possessed in their Menagerie an African Hog from the Cameroons River, to which has been given the name of Choiropotamus, or Red Hog. It is also found on some other rivers of Western Africa; and, although it had hitherto escaped the grasp of scientific naturalists, has long been known to the merchant explorers of those mysterious streams. Its nearest analogue is the Bosch Vaik of the Cape, the *Sus larvatus* of Cuvier, an animal so far from common, that no spoil of it glared upon the walls of Gordon Cumming's Trophy House, the richest museum of the African chase which has yet been gathered, or perhaps will be gathered, in the Kaffrarian wilderness. The bright red colour of the Choiropotamus, the white streak which marks the line of its back, and the long lynx-like tufted ears, are features of so striking a character, that it is almost incredible that it should, for so long a time, have escaped the numerous correspondents of the Zoological Society.

NEW AUSTRALIAN BAT.

MR. GOULD has exhibited and described to the Zoological Society, four new species of Bat indigenous to Australia, to which he gave the names of *Scotophilus picatus*, *Vespertilio macropus*, *Taphozous Australis*, *Phyllorhina* (?) *cervina*. The first of these is a remarkably beautiful species, and was obtained by Capt. Sturt, at his farthest camp in his last journey into central Australia. The others were collected by Mr. Macgillivray.

POWER OF THE WHALE.

THE REV. W. SCORESBY, D.D., F.R.S., in a Lecture at the London Institution, has stated that Whales are known to descend perpendicularly from 4200 to 4800 feet; and at the latter depth he had calculated from accurate data, that a large whale would have to sustain the pressure of 211,200 tons distributed over its entire surface, or about 137 1-7th tons on every square foot of its body.

CAUSE OF THE JET FROM THE BLOW-HOLES OF WHALES.

DR. WYMAN has remarked to the Boston Natural History Society that while on a recent visit to Labrador, he had an opportunity of observing this phenomenon. Three causes for this Jet had been assigned: *namely, the* water taken into the mouth with the food of the

animal; the water in the nasal cavities; and the secretions of the bronchial tubes. As it appears in the form of a sudden discharge of vapour, he thought a fourth explanation might be added,—the sudden rarefaction of the air when inhaled, followed by a sudden condensation when emitted. He considered it was partly due also to the small quantity of water which entered the outer extremity of the nasal passages. He had succeeded in imitating the appearance in question, by introducing a small quantity of water into the end of a syringe and suddenly expelling it, with the body of air behind it, with considerable force.

Dr. Pickering said he could not think the condensation of the air when expelled from the lungs of a whale was a circumstance of much importance in forming the jet; as in tropical climates, where this could hardly occur, the jet was as complete as in colder latitudes.

Dr. Wyman said, that in some instances he heard the inspiration as well as the expiration of Cetacea. It follows the expiration instantaneously, but it is much shorter and less audible.

Mr. Ayres, from his own observations, confirmed Dr. Wyman's views. He had noticed in a young porpoise that the act of breathing is much more slowly performed than in the adult.—*American Journal of Scientific Discovery for* 1851.

EGGS AND YOUNG OF THE APTERYX.

Prof. Owen has communicated to the Zoological Society the following "Notes on the Egg and Young of the *Apteryx*, and on the casts of the Eggs and certain Bones of *Æpyornis*." The Secretary placed upon the table casts of two eggs, and of portions of the leg-bones of a gigantic bird of the Island of Madagascar, which had been presented by the Administration of the Garden of Plants in Paris, and on these Professor Owen made the following observations. The casts were beautifully made and coloured, and were exact representations of the originals, which the Professor had examined during a visit to Paris in July last. These were received at the Garden of Plants in January 1851, and were described some months since, in a communication made by M. Isidore Geoffroy St.-Hilaire to the Paris Academy of Sciences. They had been obtained by the master of a merchantman at the Island of Madagascar in 1850, from the natives, who stated that one of the eggs had been found, entire, in the bed of a torrent, amongst the *débris* of a land-slip; a second egg, with some fragments of bone, was subsequently found in a formation which is stated to be alluvial; a third egg, which the natives had perforated at one end, and used as a vessel, was also obtained. This egg was fractured in the carriage, the other two eggs arrived entire. They are nearly of the same size, but differ in shape, the one being shorter, but a little thicker, and with more equal ends than the other. The following are admeasurements of these eggs and of an ostrich's egg:—

Greatest circumference.	ÆPYORNIS. feet.	in.	lines.	OSTRICH. feet.	in.	lines.
Lengthwise	2	10	9	1	6	0
Breadthwise	2	4	3	1	4	6
Extreme length in a straight line	1	0	8	0	6	4

M. Isidore Geoffroy estimates the larger of the two eggs to contain 10⅛ quarts, or the contents of nearly 6 eggs of the ostrich, or 16 of the cassowary, or 148 of the hen, or 50,000 eggs of the humming bird. The portions of bones, of which casts were exhibited, consist of the lower end of the right and left metatarsal bones, and the upper end of the right fibula. These are nearly equal in size to the corresponding parts of the skeleton of the *Dinornis*. From the obvious differences which M. Geoffroy found on comparing the fragments with the casts of the metatarsus of the *Dinornis giganteus*, he has inferred with much probability not only the specific but generic distinction of the gigantic bird of Madagascar, and has proposed for it the name of *Æpyornis maximus*. This distinction is illustrated not only by the metatarsal bones, but by the eggs themselves. Mr. Walter Mantell, of Wellington, New Zealand, has recorded his observation of an egg of a *Dinornis* found in the volcanic sand, of the magnitude of which he endeavours to give an idea, by stating that his hat would have been but large enough to have served as an egg-cup for it. The fragments of the egg of *Dinornis* or *Palapteryx*—of what species, of course, cannot be determined—show, after arriving approximatively at their size by the curve of the fragments, that the shell was not only absolutely thinner, but relatively much thinner than in the ostrich, and *à fortiori* than in the *Æpyornis*. The air-pores, also, have a different form, being linear, not rounded, and the external surface is smoother. In the smoothness and thinness of the shell the egg of the *Dinornis* resembles that of the *Apteryx*. In the thickness of the shell, and the comparative roughness of its exterior, the egg of the *Æpyornis* more resembles that of the ostrich and cassowary. Such colour—a dull greyish yellow, as the originals of the eggs of the *Æpyornis* now at Paris show—may well have been derived from the recent alluvial soil in which it is stated that they were discovered; the darker stain on one part of the circumference of the larger egg seems to have been due to some accidental circumstance. Most probably they were originally white, like the eggs of the ostrich and like the fragments of the eggs of the *Dinornis;* whether an original green tint, like that of the egg of the emu and cassowary, would be wholly discharged by long continuance in the soil, may be a question. It is inferred that the entire eggs of the *Æpyornis* were excluded in the usual fertile state, but had suffered such want or interruption of the heat requisite for their incubation as to have become addled.

How hazardous it is to judge of the size of a bird by that of its egg would appear, Professor Owen observed, by the remarks which he should proceed to offer on the eggs of the *Apteryx*. Of these the Professor exhibited one entire specimen, and a nearly fully incubated chick from a second egg, both of which have been most liberally

transmitted to him by the Rev. William Cotton, M.A., from the North Island of New Zealand. Had it not been for the demonstration afforded by the chick itself, it might well have been doubted whether so small a bird could have excluded so large an egg. The following are the dimensions of the egg:—

	EGG OF APTERYX.		
	feet.	in.	lines.
Greatest longitudinal circumference	1	0	9
Greatest transverse circumference	0	10	0
Length	0	4	10
Breadth	0	3	2

The egg presents the usual long oval form; the colour a dull dirty greyish white; but this is partly due to grease-stains, from the decomposition of an incompletely-hatched chick, with its yolk within. Viewed under a moderately magnifying power, the surface presents a very fine fibrous or spicular character, the raised lines, like spiculæ, crossing in opposite directions, with air-pores scattered here and there, and barely perceptible to the naked eye. The shell is not more than one-eighth of a line in thickness. Supposing, as is most probable from a comparison of the bones, that the *Æpyornis* did not equal in size the *Dinornis giganteus*, then the egg of the *Æpyornis* would be smaller in proportion to the bird than the egg of the *Apteryx* is.

The embryo *Apteryx* which had been removed from its shell had nearly reached the term of its incubation, the yolk-bag being reduced to a hernia-like appendage of an inch in length and half an inch in breadth. The whole body was clothed by down-fascicles, presenting the appearance of moderately thick cylindrical hairs, one inch-and-a half in length, with a smooth unbroken exterior, gradually tapering to a fine point. This smooth surface is due to an extremely delicate capsule, which when torn open exposes the down tuft, consisting of a central stem, with slender smooth barbs, from three to five lines in length, diverging loosely from each side of the stem.

	in.	lines.
Length of the body from the base of the beak to the tail	4	0
Length of the beak	1	7
Length of the leg from the knee-joint	4	3
Length of the freely projecting part of the fore-limb from the elbow-joint	0	6

From these dimensions it would be seen that, with the characteristic large size of the unhatched young in the genus *Apteryx*, the chief peculiarities of the remarkable external form of the bird had been acquired. The feet were very completely formed with well developed claws, the small back claw presenting its characteristic proportions, and the integument of the naked part of the foot its well-marked scutation. The little wing-rudiments had their terminal hook. The tail presented the form of a short bifid prominence. The beak, being comparatively soft, had become distorted and bent in the bottle of spirits in which the specimen was transmitted to the Professor, but it showed its characteristic shape, the terminal nostrils, and the slight terminal expansion, which *forms the end* of the crutch in the mature bird. The eye-lids with

their cilia, and the orifice of the ear, opening obliquely upwards, were rather larger in proportion than in the adult, according to the usual law of the precocious development of those organs of sense; and the same remark applies to the entire cranium. The neck is relatively shorter and thicker. The young bird must be unusually well developed, with a very complete clothing very like that of the parent, and capable of using its limbs and beak for its own safety and support.—*Literary Gazette*, No. 1828.

GUANO BIRDS.

DR. HAMILTON has read to the British Association, an interesting memoir "Upon the Marine Birds which produce Guano on the Coasts of Peru and Bolivia." The author pointed out that great stores of agricultural wealth are accumulated upon the islands which lie scattered along the west coast of South America, in the guano produced by the countless flocks of birds which inhabit them. Unfortunately, however, these islands are unapproachable by sailing vessels, or even by boats of any ordinary construction, in consequence of the high surf continually breaking upon them. Dr. Hamilton, however, described the kind of boats, or rather catamarans, in which a landing may be effected, and pressed upon the Section the necessity of Government steamers being sent out to collect the precious *rejectamenta*. A very good evidence of the faultiness of the American claims to the discovery of the Lobos Islands was produced to the Section by Dr. Hamilton, in the shape of a map bearing date 1574, in which these islands were clearly laid down.

THE LOBOS ISLANDS.

DR. HAMILTON has read to the British Association, a paper "On the Lobos Islands." Along the sea-board of Peru and Bolivia, within the Tropic of Capricorn, countless numbers of aquatic fowls exist, which live on fish, and whose excretions are exceedingly fertilizing. In some localities, the number of guanas is enormous, so that when alarmed by discharges of fire-arms, or otherwise, they rise from their nesting places in such masses as cannot be supposed by those who have never seen these birds darkening the air like a cloud. Guano producers change their habitation when continuously disturbed, but they do not permanently leave a locality which has long been frequented by them, in consequence of a temporary alarm; for, in such a case, they soon return to their old haunts, and totally abandon them only when teased by lasting annoyances. The ocean on the west coast of South America within the tropic, teems with fish, the quantity seeming exhaustless, and guanas equally abound; so that their egesta is gradually accumulating somewhere either on or off that desert land, and now has become an object sought after, not only by the Peruvian mountaineer, but by the merchant, shipowner, and statesman.

NEST OF THE BLACK REDSTART.

PROF. OWEN has read to the British Association, a paper which had been transmitted to him by Dr. Martin Barry, giving an account of a strange locality for its nest chosen by the Black Redstart (*Sylvia tithys*). At the railway station in Giessen, Hesse Darmstadt, in May, 1852, it was found that a bird had built its nest on the collision spring of a third class carriage which had remained for some time out of use. The bird was the black redstart, and the nest contained five eggs. The carriage was attached to a train and sent to Frankfort-on-the-Maine, distant between thirty and forty English miles. At Frankfort it remained thirty-six hours, and was then brought to Giessen, from whence it went to Zöllar, distant five English miles, and having been kept awhile there it again came back to Giessen; so that four days and three nights elapsed between the bringing of the carriage into use and its last return to Giessen. The nest, however, had not been abandoned by the parent birds, but was found to contain five young ones, and it was then removed by the humane wagon-master to a secure place, where he saw the parent birds visit the nest; and he inspected it himself, until at first three, and then the other two young birds had flown, none remaining at the end of four or five days.

It was concluded that one at least of the parent birds must have travelled with the train, to furnish the callow brood with the requisite warmth, shelter, and food; and the conductor of the train to Frankfort assured Dr. Barry, that whilst the train was at Frankfort, and during its short stay at Friedeberg, on the way to Frankfort, he noticed a red-tailed bird constantly flying from and to the part where the nest was situated in that particular carriage. It was doubtless availing itself of the stoppages, to busily collect the insects with which to supply the cravings of the little unfledged and unconscious travellers by that rapid mode of locomotion.—*Literary Gazette*, No. 1861.

ARTIFICIAL PRODUCTION OF FISH.

A BRIEF and lucid account of a most important subject, which has been strangely neglected, has lately been published in a shilling pamphlet, by Reeve and Co. It was proved many years ago, that a great addition might be made to the quantity and quality of our food, by taking advantage of the physiology of fishes, and that our rivers, lakes, and ponds might become the source of considerable emolument, by a proper attention to this branch of domestic economy. The ancient Greeks and Romans were evidently possessed of some method of breeding fish artificially; for it is related that Octavius bred 'giltheads' in the sea, "like corn upon the ground." Within our own time, several highly successful experiments have been made, proving that fish may be produced in the greatest abundance, and even transplanted from distant countries. Thus the *goramy* of the Indian continent, a delicious fresh-water fish, has been introduced with the greatest success by the French into the

Mauritius, and we may also cite the gold and silver fish of China, which have been naturalized both in England and in many parts of Europe.

Professor Agassiz, who has paid much attention to the Artificial Production of Fish, declared some years ago, that the ova of all fish, when properly impregnated, can be conveyed across the Atlantic as safely as if it were naturally deposited by the parent fish, so that any quantity of salmon or other spawn can (after impregnation) be carried to other streams, however distant. And Sir F. Mackenzie, of Conan, Ross-shire, in a paper published in 1841, details experiments which he made in 1840, for breeding salmon and other fish artificially, which were attended with such remarkable success, that it is surprising they were not followed up on a large scale. It appears, according to the present publication, that about the same time as the date of the above experiments, the diminution in the number of fresh-water fish in France aroused the serious attention of two humble fishermen, named Gehin and Remy, living in the obscure village of La Bresse, in the department of the Vosges, in France. They do not seem to have been aware of the labours of scientific ichthyologists, and, utterly ignorant of the nature of previous experiments, hit upon precisely the same method of artificially producing fish as had been discovered by Sir Francis Mackenzie. Their first experiment was crowned with extraordinary success. This was in 1841, only one year after those of the Scottish baronet. In 1842, 1843, and 1844, they again repeated their experiments, and in each case in the most triumphant manner. In the latter year they were rewarded by receiving a medal and a sum of money from the *Société d'Emulation des Vosges*, and in the course of a short time succeeded in stocking the waters of that part of France where they resided with "millions of trout." At the end of a few years, their operations became of such magnitude and importance as to command the attention of the French government. Gehin and Remy were accordingly summoned to Paris, and taken at once into the employment of the state, at good salaries; their duties being, first, to stock with fish, by their system, such rivers as should be pointed out to them, and next, to teach that system to the peasantry. Honours now flowed in upon them, for we are told that "they were treated as men who have made a great scientific discovery, and secured an immense benefit to their country. Many *savans* vied with each other in doing them honour, and the President of the Republic and his ministers made them dine at their tables, and figure at their receptions. A commission, consisting of distinguished scientific men, was appointed to superintend their operations."

The prodigious success of their labours may be estimated from an official report made to the Academy of Sciences in 1849, by which it appears that they had formed a piece of water, in which they had between *five and six million trout*, aged from one to three years, and the production of that year was expected to increase that vast number by several hundred thousand. Since Gehin and Remy have been taken *into the service* of the French government, they have stocked

streams and rivers in several departments of France, and have created abundance of good food where the greatest scarcity prevailed.

The shilling pamphlet before us details, in a clear and comprehensive manner, the *modus operandi* of these self-taught ichthyologists. Their system is applicable to every description of fresh-water fish, and has been tried in France with successful results on salmon, trout, carp, pike, tench, and perch.—*Literary Gazette*, No. 1850.

M. Coste, member of the Institute, and Professor of the College de France, has visited an establishment for producing fish near Huningen, founded by MM. Berthot and Detzem, engineers of the canal from the Rhone to the Rhine, to see whether it cannot be made to supply all sorts of fish in sufficient quantities to stock all the rivers, streams, canals, and lakes in the country. M. Coste states that he has ascertained, by experiments made in conjunction with Messrs. Berthot and Detzem, that the eggs of the fish may be conveyed any distance out of water without losing any of their qualities, and that they may be made, by a very simple apparatus, to become excluded or hatched, more safely than when deposited by the females in beds of streams. By this plan, M. Coste asserts that it is possible to get two yields of fish instead of one in the same period of time, and thereby to stock all the waters in France at scarcely any expense. He then goes on to say that Messrs. Berthot and Detzem have this year, notwithstanding their resources have only been scanty, produced in the reservoirs of the canal, not fewer than a million of trout and salmon. He gives a minute description of the apparatus he proposes to employ in preserving the females' eggs, and in causing them to become excluded; and he states that it will enable fish peculiar to the Rhine, to the lakes of Constance and Zurich, and to the Federsee, to be easily produced and naturalized in French waters. He next shows how the extensive reservoirs, which exist or may be created at Huningen, will allow the fish to be divided according to their species and age; and how the fish, when grown up to a certain size, may, if required, be removed from place to place. In the course of his report, M. Coste mentions the curious experiment he made some time ago of producing salmon in a vessel at the College de France, by simply causing water to flow from a cistern over fecunded eggs; and he says that the salmon so produced were then more than two inches in length, one-fifth of which they have grown within 25 days. He further announces that he has likewise succeeded in producing, also at the College de France, a considerable number of lobsters. He has returned from a government mission to examine into the system of artificial production employed at Comacchio, in the Roman States, and at Lucrino, in the kingdom of Naples. This system, it appears, is applicable to mollusca as well as to ordinary fresh-water fish; and it is carried out on such an extensive scale as to afford an abundant supply of cheap and wholesome food to large masses of population. M. Coste has brought with him a crab peculiar to the Arno in Tuscany, and its dependent streams; and he does not doubt that he *can naturalize it* in France. It can be made to breed artificially also.

Mr. Coste will be remembered as the author of the singular operation of fecundating the eggs of salmon in a washing-tub.

RARE FISH.

MR. YARRELL has exhibited to the Zoological Society, a specimen of *Echiodon Drummondii*, a very rare species of fish, first described by Mr. Thompson, of Belfast, and of which only one example has been previously known. Dr. Drummond obtained the first specimen on the beach at Carnclough, near Glenarm, in the county of Antrim, in June, 1836, cast ashore probably by the tide of the preceding night, after a strong easterly wind. The species was considered new to ichthyology, and was described and figured in the *Transactions* of this Society by Mr. Thompson, vol. ii., p. 207, plate 38. Nothing that has transpired since the publication of Mr. Thompson's paper has induced a belief that this species had been previously known. The specimen now exhibited was most liberally sent to Mr. Yarrell, by Mrs. Blackburn, of Valencia, in the county of Kerry, who was perfectly aware of the character and rarity of the fish. It was found by her daughter Helen, on the shore of the harbour of Valencia, after a violent storm from the west, which occurred on the 23rd of January 1852. This example is smaller than the one noticed by Mr. Thompson, measuring only eight inches in length, but quite perfect. Mr. Thompson's example measured twelve inches.

FISH DESTROYED BY SULPHURETTED HYDROGEN.

DR. J. L. BURTT, U.S.N., observes: one occurrence always excited much interest, whenever there was an evolution of sulphohydric acid gas (a frequent occurrence) from the bottom of the bay of Callao. The first premonition of what was to produce a remarkable destruction among fish, was the discoloration of the water of the bay, from a marine green to a dirty milk-white hue, followed by a decided odour of the gas; so much of it being present on many occasions as directly to blacken a clean piece of silver, and to blacken paint-work in a few hours.

The fish, during this evolution, rose in vast numbers from the bottom, and after struggling for some time in convulsions upon the surface, died.

Dr. Burtt was particularly struck by this fact, that all of them, during the time they were under its influence, acted in precisely the same manner. The first thing noticeable with regard to its effect upon them was, that on coming near the surface, they seemed to have much difficulty in remaining below it at all. They then rose completely to the surface, struggling vainly to dive beneath. This was followed by a violent springing and darting in various directions,—evidently without control of direction—for they moved sideways, or upon the back, and sometimes tail first, with great velocity. After a little time their motion became circular, and upon the back, the circle of gyration constantly diminishing, and the rapidity of the motion as constantly increasing, until there was a sudden cessa-

tion of all motion. The head then floated above the surface, the body being in a perpendicular position. A few convulsive movements shortly followed, and they were dead.

Dr. Burtt has watched thousands of them so dying, and in every instance such was the mode of death. Having taken them at the moment of death, and immediately after, a rude examination showed in all the same appearance. The intestines and brain were gorged with blood, much darker than natural. The gills were almost black, and the air-bladder ruptured.—*Proc. Nat. Hist. Soc. Philadelphia.*

OVA OF THE SALMONIDÆ.

Dr. Davy has communicated to the Royal Society, some researches, commencing by a quotation from the work of M. Vogt on the Embryology of the Salmonidæ, in which a remarkable property of the Vitellus is described, viz. its coagulation by admixture with water.

This inquirer's experiments were made chiefly on the Ova of the *Palée* (*Coregonus Palæa*, Cuv.); the author's mostly on the Ova of the Charr (*Salmo Umbla*). After giving a description of the mature eggs of this fish, he details the trials instituted by him:—1st, On the action of water, showing its coagulating effect, except when added in very minute quantity. 2ndly, On the action of heat; how that a dry heat, even so high as that of 212° Fahr., occasions the contraction of the vitellus from evaporation, but not its coagulation, an effect even not produced by steam of the same temperature, but which is occasioned by boiling in water, owing, it is inferred, to an admixture of water. 3rdly, On the action of alkalies and salts; how these, such as potassa, ammonia and their sesquicarbonates in solution, nitre, acetate of lead, common salt and others, when of moderate strength, not only do not coagulate the vitellus, but have the property of dissolving a certain portion of coagulum, and coagulate it only when very much diluted. 4thly, On the action of acids and some other agents; how the vegetable acids tried, as the tartaric, oxalic, acetic, whether strong or dilute, do not coagulate the vitelline fluid, but dissolve its coagulum; how the strong sulphuric and muriatic acids inspissate it, the weak coagulating it; and further, how it is coagulated by the nitric acid, by corrosive sublimate and by alcohol, but not by iodine.

The inference from the experiments drawn by the author is, that the vitellus of the Charr and of the eggs of the other Salmonidæ is distinct in its properties, both from the albumen and yolk of the eggs of birds. He conjectures from analogy that the ova of other species of osseous fishes will be found to be similar; but not so those of the cartilaginous fishes. According to the observations he has made, the yolk of the eggs of fishes of this order, whether they possess a white, as in the instance of the oviparous; or are destitute of a white, as in that of the viviparous, resembles in its general character that of the egg of birds: but he doubts that the white of the former will be found analogous to that of the albumen ovi of birds, at least in its chemical qualities; having in one instance, that

of the egg of the *Squalus Catulus*, found it to be, whilst transparent and viscid, neither coagulated by heat nor by nitric acid.

In conclusion, D. Davy suggests that the coagulation of the ova of the Salmonidæ may have its use, inasmuch as the opaque white ova are more conspicuous than the transparent,—the dead than the living; and in consequence, the one may serve as lures, and divert from the others the many enemies to whom they are attractive food.

RIVER FISHES OF CEYLON.

COL. HAMILTON SMITH has read to the Zoological Society, a paper upon the River Fishes of Ceylon, illustrated by eight drawings, which had been transmitted to him by his friend and correspondent, Major Skinner, who had taken all the species represented in them in the upper part of the Mahavilla Ganga, the sacred river of Budha, which flows at the foot of Adam's Peak. Among these fish were two species considered by Col. Smith to be new, which he characterized under the names of *Mastacemblus Skinneri* and *Polyacanthus Pulatta*.

RED ANT FLIES.

A CORRESPONDENT of the *Sussex Express*, whilst walking in Romney Marsh, saw at about 5 P.M. what appeared to him a column of smoke, about a quarter of a mile distant, and the same extent in length, and from 50 to 100 yards in circumference. He states the column to have darkened the sky, and a vast number of its flies to have fallen into the Rother, the water of which was blackened by them. He adds: "I watched the column for a mile and a half, and notwithstanding the number left in the river, and on the trees, hedges, &c., over which it passed, the column appeared like a wreath of dark smoke. The extraordinary thing is, that the ant-flies throughout the whole marsh, 30 miles in length, should all have taken wing at the same time and collected together in such vast numbers. A man who was collecting ants' eggs found himself covered with the flies, running up to the top of the strands of grass, and then taking wing. After the flight, he hardly found one ant-fly in the nests. Other persons who saw the flight considered the length of the column to be a mile. The wind was in the east, the temperature very sultry, and there was every appearance of a thunder-storm. The column travelled at the rate of five or six miles an hour. An interesting account of these flights, and the reason, will be found in the 2nd volume of Kirby and Spence's *Entomology*, pp. 50, 51, 52."

FLY-BLIGHT OF AUSTRALIA.

MR. SPENCE has read to the Entomological Society a note on the "Fly-blight" of Australia, by which designation is known the attack of a small fly on the eyes of persons in that country, resulting in inflammation and temporary loss of sight. The name of these insects is not known, and it would be interesting to receive a few specimens

in order to determine it. It had been discovered that they could be kept from the face by open nets suspended over it, and fixed under the hat; for although the meshes were large, and therefore offered no obstruction to the passage of air, yet the flies would not go through them. Mr. Spence observed, that the principle was evidently the same as that of the Italian window-nets, introduced to the notice of this Society eighteen years ago, and proved by the late Bishop of Norwich to be quite effectual in keeping flies from entering apartments. The same plan would probably serve to protect travellers and others from gnats, which in many places are such intolerable pests—even the highest latitudes being infested with them in summer; and Mr. Spencer had suggested it to Sir John Franklin as likely to be of service on that Expedition the uncertain issue of which excites so much interest.

LEAP OF THE GRASSHOPPER AND THE FLEA.

Dr. Martin Barry, in his renewed Inquiries concerning the Spiral Structure of Muscle, observes:—"Muscle from the thigh of the Grasshopper having uniformly presented a relaxed state, it appeared to the author probable that such a state was not unconnected with the sudden muscular contractions required by this creature for its leaps. A sudden change from such a state of relaxation to that of extreme contraction must here take place with the greatest facility, and be combined with the manifestation of great power. This opinion having been mentioned to Professor Purkinje, the latter recommended the author to examine the corresponding muscle from the Flea, in which, from its enormous leaps, something similar would, he thought, be found. The author accordingly examined some of these, and had the satisfaction to find in them a degree of muscular relaxation even higher than that he had observed in the grasshopper. Similar conditions, no doubt, exist in other animals, but perhaps nowhere are they more remarkable and constant than in those just mentioned."

SILKWORMS IN GERMANY.

The breeding of Silkworms is becoming an important branch of industry in Germany; and it is so in northern as well as in the southern parts, though the general impression is, that silkworms cannot thrive in a northern temperature. Since 1821, the production of silk has become considerable, not only in Prussia, but in the other States of the Zollverein; the annual production is at present several thousand pounds. In quality it is remarkably white, and finer than that in the southern countries; and Berlin manufacturers say that if enough of it could be obtained, they would not apply to the producers of Lombardy. From Berlin and Potsdam the cultivation of mulberry-trees has gradually extended to Silesia and Hanover. It is schoolmasters who chiefly occupy themselves with it—one of their body having in the eighteenth century commenced it as a means of adding to his income; and some of these persons now gain from 20 to 80 thalers (75fr. to 300fr.) annually. Several of the

German governments encourage the production of silk by granting premiums, and causing societies of patronage to be formed. In the Grand Duchy of Baden, the roads and sides of the railways have been planted with mulberry-trees, and in the village of Saint Ilgen, near Heidelberg, the breeding of silkworms has been carried on, during the last twelve years, on an extensive scale. Austria, on its part, is sparing no pains to increase its production, which already amounts to about 100,000,000fr. annually—one half coming from Lombardy alone. On the military frontier of Turkey, a garden of mulberry trees has been established in every village, and the military colonists are encouraged to extend the cultivation. At Prague, the fosses of the fortifications have been planted with mulberry-trees, and orders have been given that such trees shall also be planted by the side of all the railways in the monarchy.—*Galignani's Messenger.*

SILKWORM FOOD—THE CENTINODE PLANT.

THE *Diario Mercantile* of Venice reports that on a recent visit of the Duke and Duchess of Montpensier, they received the royal and imperial commissioner of agriculture, who presented to them a certain Teresa Ramor, who had raised, and produced silk from silkworms in 16 days, nourishing them with quite a different leaf to that of the Mulberry. It goes on to say "This is the perfect realization of the discovery of Anna Rizzi, who could bring up, even in winter, silkworms, giving them the leaves of the grass classed by Linnæus under the name of *Polygonum Centinodis.*" This grass, according to the "Adriatico" of Venice, if even given at the same time as the leaves of the mulberry, is preferred by the silkworms.—*James White, Kennington.* [This Centinode is identical with the common *Polygonum aviculare,* called in this country Knot-grass.]

WOOL FROM THE VEGETABLE KINGDOM.

THE name of Vegetable Wool has been applied to a fibrous material which the ingenuity of M. Pannewitz has succeeded in extracting from leaves of the fir. A manufactory of this material has for some time past existed near Breslau, in Silesia, in a district termed the "Prairie of Humboldt." The species of pine there operated upon is the *Pinus Sylvestris,* or wild pine; it would seem that every member of the pine tribe might be turned to similar account. The leaves of these trees, if examined, will be found to be made up of a fibrous material, held together by a resinous substance. The latter may be dissolved out by means of alkalies, leaving the woolly matter behind. Coverlets, blankets, and other articles made of vegetable wool have long been employed in Austria, Vienna especially, in some of the charitable institutions. The materials are warm, durable, and agreeable to the eye; moreover they enjoy the excellent quality of preserving a certain balsamic and rather agreeable smell, which nevertheless is so inimical to insects that they never harbour in it. In the Silesian manufactory, the resinous matter holding the woolly fibres together is also turned to account, medicinal

baths being made with it as a basis, and which are found to be useful in many chronic diseases.

DEATH FROM THE BITE OF A COBRA DE CAPELLO.

ON Wednesday, Oct. 12, Edward Horatio Gurling, a Keeper in the Gardens of the Zoological Society, Regent's Park, lost his life, owing to his own imprudence, from the bite of a Cobra de Capello.—The way in which the accident happened is soon told, and leaves no room for conjecture; but the singularity of the case, and the circumstance that it afforded unusual facilities for medical research into the action of wounds from venomous reptiles, invested the evidence at the inquest held upon the deceased with more than ordinary interest.

The body, when viewed by the jury, presented no very unusual appearance, not being swollen or otherwise disfigured, and the mark of the serpent's bite being indicated only by a slight discoloration on the bridge of the nose. The accident occurred in the Serpent-house, which is fitted up in such a manner as, with the most ordinary precautions, to insure perfect safety from casualties of the kind. By means of an iron rod, hooked at one end, and inserted through the small aperture at the top of each compartment, the reptiles are easily removed into the compartment next their own, and made secure there, while the keepers place food in and clean out the empty one. Visitors are enabled to see the serpents in perfect security through the thick glass fronts of the compartments, and nothing can be better than the arrangements of the society in this portion of their display, the keepers having the strictest orders never on any account to lift the glass slides, or to attempt doing anything in the compartments, without first removing their occupants. The Cobra which inflicted the fatal wound is that found in India, Ceylon, and the adjacent islands, and differs from the African Cobra, a specimen of which is placed beside it, in having its skin marked with rings of a dirty yellow colour.

On the commencement of the inquest proceedings, the first witness called was Mr. G. F. Burder, house-surgeon at the University College Hospital, who said that he was present at the death of the deceased, which happened on the morning of Wednesday, the 12th of October, at half-past 10. He had been there about an hour before the event took place. When taken in, he appeared almost if not quite unconscious, and unable to support his head. His face was livid, his respiration very imperfect, he moved himself uneasily, and pointed to his throat and moaned. The pupils were rather large and acted very imperfectly, the left, however, being most active. The surface of the skin was of the natural temperature, and the pulse pretty good and strong. He never spoke after his admission, and could not walk or stand. Witness had him taken at once to a ward and put to bed, when artificial respiration and galvanism were at once resorted to. He seemed quite unable to swallow. The artificial respiration seemed able to keep up the action of the heart after natural respiration had ceased, but he rapidly sank, and galvanism had no effect. About five minutes after his admission respiration was at 20, but then shallow, and it shortly after became very slow and ceased. His eyes were partially open throughout, but did not give indications of paralysis. The wounds were small punctures on either side of the bridge of the nose, symmetrically placed, four on the right side, and six on the left. The right eyelid was swollen, but the left not at all. The largest puncture *would be about* one-sixth of an inch in diameter, and the deepest was about an

eighth of an inch. It had penetrated through the skin into the cellular tissue, but witness could not detect any mark in the periosteum. The face was more livid than is usual before death, and continued much so for some time. It extended, on the *post-mortem* examination, half way down the neck, and also about the back. Witness had never seen a case of the kind before.

The *post-mortem* examination was made 20 hours after death. In the brain there was no unnatural congestion, and the same might be said of the spinal column, except that it seemed unusually soft in the lower part. The chest and lungs were less collapsed than in ordinary cases, which might be attributed to artificial respiration, but towards the back part of both lungs they were intensely congested, were black in colour, and a blackish froth issued from the tissue. The mucous membrane of the inner passages was of a very dark colour, and the passages themselves were filled with a dark frothy fluid. The same sort of fluid had also issued in considerable quantities from the wounds, between the death and the *post-mortem* examination. The artificial respiration was continued for 40 minutes after the natural respiration had stopped, and until the pulse ceased to beat. There was nothing unusual about the larynx or glottis, and there was no sign of constriction. The black colour of the mucous membrane commenced in the lower part of the trachea, and increased as it descended. There was nothing unusual in the pericardium, and the heart was free from disease. The left cavities were firmly contracted and free from blood; the right were moderately full of dark-coloured blood and a small quantity of very loose coagulum. The stomach had patches of dark-coloured spots like ecchymosis, the surface of the mucous membrane being mottled and in some parts red, in others pale. The stomach contained a small quantity of fluid, but witness could not say of what kind. The intestines were healthy throughout; the liver was of a darkish colour on the surface and in sections. The kidneys, though sound, were much congested. The spleen was excessively congested, almost black in colour, and very soft. The deepest of the punctures had been constantly since death exuding a thin bloody fluid. There was an ecchymosis under the skin, such as might take place from any other puncture, but no unusual inflammatory action.

The Coroner.—Did you discover the cause of death?

Witness supposed it was from asphyxia, and he had no doubt that it was caused by poison. Some of the *post-mortem* appearances could be accounted for as the result of the artificial respiration, but others resulted from the poisonous bite of a serpent.

The Coroner declared his conviction that the case was a hopeless one from the commencement, and that the only thing that could have given deceased a chance was to have sucked the wounds at once. He would not, had he been present, have hesitated to do so.

The following evidence describes the way in which the accident occurred. Edward Gurling, one of the attendants of the humming-bird collection, was present when the fatal accident took place, and was going out of the room with a basket of sparrows, when the deceased, who was in an excited state, walked inside of the railing which fenced off the compartments in which the serpents are confined, and lifting up the glass front took out a Morocco snake by the middle. Another man entered the room at the time, and witness, turning round to Gurling, said, "For God's sake put it back again!" He replied, "I am inspired," and laughed at witness. He then laid the snake round the shoulder of witness, who stooped down, and said, "It will bite me in a minute;" after which he put it back. Witness then walked down the room, going on with his work, when the deceased, who was close beside him, inside the railing, exclaimed, "Now for the cobra!" Witness called out, "Good God! what are you about?" but he had the cobra out before he could prevent him, and put it under his waistcoat. It coiled round his waist

and came out behind; when, taking hold of it, about a foot from the head with one hand and with the other lower down, he held it up in front of his face. It then flew at him, and witness saw the blood flowing from the bridge of his nose. Gurling said to him, "Run for Hunt," and he ran off accordingly. How long he was away he could not tell, being in a maze, but deceased must have put back the snake in the interval, for he was in his compartment and the front glass closed down. Evidence was then given that Gurling was intoxicated at the time he was bitten by the cobra.

Mr. D. W. Mitchell, the Secretary to the Zoological Society, and chief executive officer under the Council, stated that Gurling, when placed in the Serpent-house, was told, on no account, at any time, to do anything to the different cases when the snakes were in them. On one occasion, Mr. Mitchell remembered rebuking Gurling very severely for lifting the glass and putting in food for the snakes inside without removing them.

Mr. S. Alford, a surgeon, who was present on the occasion, confirmed Mr. Mitchell's evidence as to Gurling's having been severely reproved for feeding the puff-adders by lifting the glass. He threatened to discharge him on the spot if he ever did so again, and told him that if the animals bit him it would cause instant death.

James Phillips, engineer to the Society, saw Gurling directly after he was bitten. He came to him with his arm extended and blood on his face, and took him round the neck and begged him to get him medical assistance, as he had been bitten by a cobra, and was a dead man. He then went to the sink and washed his face. He told witness that he had placed the animal in his breast, when it bit him.

Mr. Mitchell said, that there was an alleged antidote to snake bites, called the *Sibama Cedron*, which, however, he did not believe in; and some of it had been given to the deceased, who had not used it.

This closed the evidence; and the coroner having briefly charged the jury, they returned a verdict to the effect that the deceased had lost his life by the bite of a serpent known as the Cobra de Capello, when in a state of intoxication, and in consequence of his own rashness and indiscretion.

EXPERIMENTS WITH ANIMALS BITTEN BY VENOMOUS SERPENTS.

Mr. D. R. Evans has communicated to the *Times* of Nov. 9, the following details of experiments made on July 8 last, in the presence of himself, Dr. Quain, Mr. Squire, the chemist, Mr. Wyatt, and Mr. Mitchell, the Secretary of the Zoological Society, who undertook all charges for animals and *materiel;* the object of the experiments being to test the efficacy of a powder called *Simaba Cedron*, in high repute among the Indians as a remedy for the bite of poisonous reptiles.

The animals experimented on were rabbits, guinea-pigs, and sparrows; and the serpents to whom they were offered were rattlesnakes, cobras, and puff-adders. The cobras, though tempted with birds, remained passive and could not be provoked to bite. First, then, upon the introduction of an animal into their cage, the serpents became greatly agitated, raising themselves, and moving with a

quick angular motion into attitudes of defence—sometimes, indeed, showing fear, evidenced by retreat into the tank containing water below the level of their cage. This, however, soon subsided, and one of the group, as if by general consent, was left watching the prey and showing a purpose to strike it. The others coiled themselves up, and thereafter showed the immobility for which reptiles are remarkable, both puff-adders and rattlesnakes permitting the rabbits and guinea-pigs to walk over them with impunity. The attitudes and movements of the serpent intending to bite were very striking and beautiful. In the first place, he made, with the posterior half of the body, a bold curve, having a strong prehensile "purchase" on the floor of the cage, so as to secure a steady fulcrum for the rapid dart made at the time of the bite. The upper half of the body was raised some ten inches or a foot, the neck strongly arched, and the head, bent nearly at right angles with the neck, was poised directly opposite the prey. In such position the serpent remained a greater or less time (sometimes as long as 20 minutes) according to circumstances. During this interval, the slightest motion of the animal before him was followed by an instantaneous and corresponding movement of the head and neck of the serpent. The purpose seemed to be that of aim-taking, for the eyes were intently fixed upon the prey; but Mr. Evans is by no means sure that the snake, knowing that the latter cannot escape him, does not derive pleasure from this prolonged and intent gaze. At all events, in one experiment, where the head of a rattlesnake so engaged was sideways to the glass of the cage, and near it, Mr. Evans observed, and called attention to the fact, a remarkable vermicular motion along the course of the poison-gland to the opening of the angle of the mouth, which was thought might afford him pleasure, and this continued until the snake struck its prey. All these serpents seem to prefer striking when the animal is about a foot distant; when directly under and close to the head they would not strike. The blow itself was very rapid; and although the united purpose of five observers was to detect the spot where the wound was inflicted, it was seldom any one succeeded. The puff adders at first hissed violently and swelled to double their usual thickness. The cobras raised themselves and spread out their beautiful hoods. The rattlesnakes retired and then advanced, but emitted no sound; and the one that did not bite soon returned to his former passive condition. The bite of the rattlesnake, as will be seen, caused the most speedy death.

So far the serpents. Mr. Evans then describes the peculiarities shown by the animals on which the experiments were made. Not one of the guinea-pigs or rabbits (which were all something under their full growth) had ever seen a serpent, yet when introduced to the cage they showed unequivocal systems of distress and fear. In some instances they actually screamed before they were struck. They generally showed restlessness at first, but when the serpent, intending to strike, poised himself in front, both snake and prey became motionless; this being either a pleasurable paralysis of the animal's powers, or a deprivation of the power of motion from terror, lasting several minutes.

. Mr. Evans then details the experiments:

First Experiment.—Puff-adder (*clotho arietans*) and guinea-pig.—Struck by snake and screamed at 8h. 54 min. A.M. Convulsions supervened in one minute. An infusion of the *Simaba Cedron* was poured freely down the throat, and the moistened powder applied to the wound. The convulsions (like a painful hiccough) gradually increased in violence and frequency. At five minutes after the blow the pupil was insensible; the animal gasping for breath; its nose, lips, and feet (originally flesh-coloured) became first pale and then livid. In 8½ minutes the convulsions had ceased, the bladder contracted and emitted its contents, the quantity being very large for the size of the animal. In 10 minutes the guinea-pig was quite dead. After this we could not induce another puff-adder to bite. We tried the cobras with a like disappointment.

Second Experiment.—Cascarilla rattlesnake (*crotalus horridus*) and guinea-pig.—Struck behind the ear, near the jugular vein; dead before he could be carried to the table, certainly within a quarter of a minute. There were no convulsions. Unable to use the antidote. On a dissection roughly made by Dr. Quain (for, our object being to test the value of an alleged remedy, and not to note all the morbid appearances, we had not provided proper instruments) there was observed an effusion of dark-coloured blood below and around the wound; it extended from the jugular fossa to the spinal canal, and even within it, giving to Dr. Quain an impression that the spinal cord itself had been injured more or less by the powerful fangs of the serpent—a conclusion which would account for the wonderful rapidity of death. One very interesting fact was witnessed in this experiment. I saw, for the first time, the beating of an animal's heart. It has been stated that the heart of Bellingham, the assassin of Mr. Percival, beat for a considerable time after removal from the body. Several minutes after apparently complete death the heart of this animal continued its pulsations. For every contraction of the apex of this organ there seemed to be two of its auricles, which were gorged with venous blood. Generally there was much congestion of the vessels.

Third Experiment.—Same snake and a guinea-pig.—Struck and screamed at 9h. 26 min. 45 secs. The bite was on the left side, near the hind leg. In ten seconds the eye closed, and there followed a complete paralysis of the hind quarters. The remedy was applied. Slight convulsions supervened. Spasm of the diaphragm and gasping for breath within four minutes; pupil insensible in six minutes; animal dead in ten minutes. It is remarkable that in the last two experiments there was far less convulsion than in the case of the animal bitten by the puff-adder.

Fourth Experiment.—On a sparrow.—A sparrow was inoculated with blood taken from the right auricle of the guinea-pig dissected, but it produced no perceptible effect.

Fifth Experiment.—Same rattlesnake and a rabbit.—Struck underneath the right thigh at 10h. 4 min. 20 secs. The antidote administered and applied within a minute. The right leg was immediately paralysed, and it dragged. At 10h. 7 min. 30 secs. both hind legs were paralysed. Panting for breath at 10h. 8 min. He seemed to have partially recovered the use of his hind legs, and lost that of his fore legs at 10h. 11 min. We thought him dying, without convulsions, at 10h. 12 min. 15 secs. Subsequently, the animal, after recovering the use of his fore legs, and once more losing that of the hind legs, seemed to rally; and to give him the better chance, he was removed from the reptile-house and laid on the grass in the sunshine, but he died at 10h. 40 min., having survived the bite just half-an-hour.

Sixth Experiment.—Same rattlesnake and a strong rabbit.—Struck at 10h. 30 min. 7 sec. in the ear, which immediately drooped. The bite perforated the ear completely, about an inch from the base. The rabbit shook his head and ear; we placed him on the floor, and he ran about. In 10 minutes he seemed none the worse; he was therefore again put into the cage, and struck near the root of the same ear, about half an inch from the right eye, at 10h. 48 min. The remedy was applied. He screamed as if from pain in about a minute, and cried a second time a few seconds afterwards. Slight spasms supervened at 10h. 50 min.; he was quite dead at 10h. 52 min. Lived just four minutes. Dr. Quain dissected the animal five minutes after death, and found an effusion of dark blood in the course of the wound, such as described in Experiment 2. The fangs had perforated the carotid canal, and the vessel there contained a coagulum about half an inch in length, which nearly filled its cavity.

Seventh Experiment.—On a sparrow.—I inoculated a sparrow on the inside of the wing, near the heart, with blood from the wound caused by the fangs of the rattlesnake, but without apparent effect, for in 15 minutes he seemed uninjured. This accords with Dr. Russell's experiment by inoculation made in India. The keeper afterwards stated that one of the two sparrows died the next day, but not, as he thought, from the inoculation, for he found sparrows frequently die in the reptile-house when untouched by the serpents.

The practical value of these experiments Mr. Evans considers to be in the proof that the alleged remedy *Simaba Cedron* was inefficacious as an antidote, unless it had some effect on the rabbit which revived half an hour; still, Mr. Evans thinks, the *Simaba Cedron* should not be repudiated until it has been tried, and has failed upon stronger animals than the above. It is remarkable that the poison of the rattlesnake and of the puff-adder operated in a different manner. There was very little convulsion in the animals bitten by the former; they seemed to have their vital powers paralysed at once, to sink into a comatose state, and die; while the spasms and convulsions following the bite of the puff-adder were violent, and increased in force and frequency till death ensued. The fourth bite of the same rattlesnake caused death in four minutes.

Some interesting questions arise on these experiments. What is the action of this deadly poison? Is it through the blood or the nervous system? There are presumptions both ways. The probability that it acts through the blood reposes on the observed fact of discoloration around the wound, and the coagulum found in the carotid artery, as described in Experiment 6. On the other hand, the presumption that it operates directly on the nervous system is strengthened by the following observations;—firstly, by the extreme rapidity of death—the animal in Experiment 2 seeming to die instantaneously; secondly, by the observed effect of immediate paralysis of the limb nearest to the wound, followed by paralysis of the corresponding limb, though death did not directly follow (Experiment 4), and the drooping of the ear of the rabbit (in Experiment 6) simultaneously, as it appeared to us, with the bite. May not the poison act both through the circulation and the nervous system? Mr. Evans thinks it does, and that any remedy, to be efficacious, must operate upon both.

One of the persons who assisted at the above experiments was Gurling, the keeper, whose enthusiasm for his occupation was very remarkable, and whose indiscretion led to his death by the bite of a cobra within four months from the above date.

EXPERIMENTS WITH THE POISON OF THE TOAD.

ALL doubts as to the poisonous nature of the contents of the skin pustules of the Toad have been set at rest by recent experiments of MM. Gratiolet and S. Cloz, who have demonstrated by inoculating various animals with the cutaneous poison of toads and salamander lizards, that the substances are endowed with well-marked, dangerous, even fatal properties. The first experiment of these gentlemen was prosecuted on a little African tortoise, which having been inoculated with some of the toad poison in one of its hinder feet, *paralysis of the limb supervened,* and still existed at the expiration of eight

months, thus demonstrating the possibility of local poisoning by this agent. In order to determine whether the poisonous material spoiled by keeping, the gentlemen above mentioned procured about 29 grains of the poison on the 25th of April, 1851, and having placed it aside until the 16th of March, 1852, they inoculated a goldfinch with a little of this matter. The bird died almost immediately. Subsequently, the investigators succeeded in eliminating the poisonous principle from the inert matters with which it is associated in the skin pustules of the toad and the salamander, and found that, when thus purified, its effects are greatly more intense than before. Like most of the known strong organic poisons, the active principle of toad-venom is alkaline in its character—almost insoluble in water, slightly soluble in ether, and very soluble in alcohol.

THE ESKIMOS.

THE Eskimos are essentially a littoral people, and inhabit nearly 5000 miles of sea-board, from the Straits of Belleisle to the peninsula of Alaska; not taking into the measurement the various indentations of the coast-line, nor including West and East Greenland, in which latter locality they make their nearest approach to the western coasts of the old world. Throughout the great line or range here indicated, there is no material change in their language, nor any variation beyond what would be esteemed in England a mere provincialism.

The origin of the Eskimos has been much discussed, as being the pivot on which the inquiry into the original peopling of America has been made to turn. The question has been fairly and ably stated by Dr. Latham, in his recent work "On the Varieties of Man;" "and," says Sir John Richardson, "I shall merely remark, that the Eskimos differ more in physical aspect from their nearest neighbours, than the red races do from one another. Their lineaments have a decided resemblance to the Tartar or Chinese countenance. On the other hand, their language is admitted by philologists to be similar to the other North American tongues in its grammatical structure; so that, as Dr. Latham has forcibly stated, the dissociation of the Eskimos from the neighbouring nations, on account of their physical dissimilarity, is met by an argument for their mutual affinity, deduced form philological coincidences."—*Arctic Boat Expedition.*

SPIRAL STRUCTURE OF MUSCLE, AND THE MUSCULAR STRUCTURE OF CILIA.

WE rejoice to learn that our distinguished friend, the celebrated physiologist, Dr. Martin Barry, has so far recovered from his long illness as to be able to resume his microscopical investigations, and has lately published an account of his renewed researches on the Spiral Structure of Muscle.

In the year 1842, Dr. Barry, in a memoir published in the "Philosophical Transactions" of the Royal Society, recorded his discovery of the spiral structure of muscle. Two or three to whom he had shown *the tissue* with his own microscope believed what he wrote, but by *most persons* it was doubted, by some flatly denied. Dr. Barry's

eye-sight became affected, and for years that instrument remained unused.* But our friend's sight was at length improved. He was in the same city (Berlin) with the celebrated physiologist, Purkinje, and showed him that muscle had a spiral structure, and added the very interesting observation, that cilia are no other than little muscles. He now wrote a fresh paper, containing an account of his renewed researches on muscle and of the muscular character of cilia. Purkinje translated that paper into German, and communicated it to Müller's Archiv., where it occupies sixty-eight pages octavo, with numerous engravings. Although we cannot, from the number of the gravings, give this very valuable contribution to science a place in our Journal, we embrace this opportunity of recommending it to the particular attention of naturalists. They will find in it a confirmation of Dr. Barry's observations published nine years ago, "that the structure of muscle is a spiral structure," and discover (not published before) that cilia have a truly muscular character and structure; this being demonstrable, not only in cilia from the gill of the oyster and the common sea mussel, but in those of the Infusoria. (But, of course, if any cilia are muscular, all cilia are so.)—*Jameson's Journal*, No. 105.

INFUSORIA, THE EARLIEST LARVAL STATE OF INTESTINAL WORMS.

Although for want of time, (says Agassiz, in a letter to Mr. Dana,) my investigations on Intestinal Worms have been limited, I have arrived at one important result. You may remember a paper I read at the meeting at Cambridge (America), in August 1849, in which I showed that the embryo which is hatched from the egg of a *Planaria*, is a genuine polygastric animalcule of the genus *Paramecium*, as now characterized by Ehrenberg. In Steenstrup's work on Alternate Generation, you find that in the extraordinary succession of alternate generations ending with the production of *Cerceria*, and its metamorphosis into *Distoma*, a link was wanting—the knowledge of the young hatched from the egg of Distoma. The deficiency I can now fill. It is another infusorium, a genuine *Opalina*. With such facts before us, there is no longer any doubt left respecting the character of all these Polygastrica; they are the earliest larval condition of worms. And since I have ascertained that the Vorticellæ are true Bryozoa, and botanists claim the Anentera as Algæ, there is not a single type of these microscopic beings left, which hereafter can be considered as a class by itself in the animal kingdom. Under whatever name, and whatever circumscription, it has appeared or may be retained to this day, the Class of *Infusoria* is now entirely dissolved, and of Ehrenberg's remarkable investigations, the descriptive details

* Some observers had also declared, that when Dr. Barry saw spermatozoa within the ovum of the Rabbit, he saw too much. But since Dr. Barry's announcement spermatozoa have been found in the ovum by others. In papers laid before the Royal Society, the author of one of them found them within the ovum of the *Ascaris mystax*, and the author of the other, who denied the fact, confessed that he was obliged *to cry peccavi*, others finding them for him within the ovum *of the frog*.

alone can be available in future; the whole systematic arrangement is gone.

This result has another interesting bearing; for it shows the correctness of Blanchard's view respecting the *Planariæ*—their close relation to the intestinal worms under the name of *Trematoda.* Indeed, they belong to one and the same natural group.

Is it not remarkable that the two types of the animal kingdom long considered as the fundamental supporters of the theory of spontaneous generation, should have finally been brought into so close connexion; and that one of them—the infusoria—should in the end turn out to be the earliest larval condition of the other,—the intestinal worms being the parents of the infusoria?—*Silliman's Journal,* May, 1852: *Jameson's Journal,* No. 106.

FISH-HOUSE AT THE ZOOLOGICAL GARDENS, REGENT'S PARK.

FOREMOST among the new arrangements of the past year is the Fish-house, an elegant structure in the south garden, built in the style of a conservatory for plants. At each end of this building are tanks,—and on the other sides are glass-cases for the purpose of containing fish. The fish properly so called occupying at present the cases and tanks are, British fresh-water fish. In this fish-house we see at a glance what days of watching elsewhere could not afford. The ferocious pike has here become as docile as a puppy; the perch —always invisible amongst the deep holes of rivers and lakes—here yields up the secret of his haunts. We anticipate much interesting information about the economy of fishes from the facilities afforded for observation by these cases. But why should we not have sea fishes?—These are to come. Something of a commencement has been made. Several species of Actinia, or Sea Anemones, are here to be seen expanding their beautifully coloured arms amid the fronds of olive green and bright red sea-weeds:—and they are but the first-fruits of what we may expect. Ere long, every inhabitant of London will be able to see what up to the present time has been seen only by the adventurous and sea-tossed dredger, who, casting his net to the bottom of the ocean, has beheld its numerous inhabitants in the freshness of life. The Sea Anemones are to be followed by all the other forms of Zoophytes,—with Jellyfishes and Starfishes, the delicate Nudibranchiate Mollusca, rare forms of shell-fishes, and the various species of Crustacea.—A new world of animal life will be drawn from the depths of the ocean for the amusement and instruction of the present generation.

We should mention that Mr. Mitchell, the indefatigable Secretary of the Society, has written a popular Guide to the Gardens,—which contains a large amount of useful and interesting information. It is embellished with several woodcuts.—We are promised, besides, a list of all the animals which have been received and have existed in the Gardens during the last five years,—together with a more elaborate account of them than that given in the Guide. This will be published as a separate work,—and illustrated by the accurate hand of Mr. Wolf.—*Athenæum,* No. 1317.

BOTANY.

VEGETATION OF AUSTRALIA.

The Secretary of the Linnæan Society has read some remarks on the Vegetation of the Districts surrounding Lake Toneus, from a letter addressed to R. Kippist, Esq., curator of the Society, by Dr. Ferdinand Müller, of Adelaide, in South Australia. The district immediately surrounding the lake was represented as sterile and uninviting. On the salt plains near the lake, species of the European genera *Blitum Cotriplex,* and others, were observed. The hills surrounding the lake did not present the aspect of tropical or northern forest vegetation. Along the course of the river a rich vegetation was observed,—the most striking feature of which was, the resemblance of the genera to those found in Europe and in Asia. The author concluded by stating, that his enumeration of the plants found in this district proved that the Flora of Northern Australia was not so barren as was represented by Mr. Brown. The President vindicated his statement with regard to the general characteristics of the Flora of the North of Australia. Dr. Müller's remarks confirmed his observations—as the vegetation which he had described was clearly exceptional. Probably the spot was an isolated one formed by an ancient lagoon.

VEGETABLE TRANSFORMATION.

An interesting point in vegetable physiology has been treated by Major Munro, in a communication to the British Association, on the transformation of *Ægilops* into *Triticum;* the gist of which was, that while our wheat has unquestionably been derived from the wild *Ægilops,* the other kinds of domestic grain have had an altogether different origin.

INFLUENCE OF COLD ON PLANTS.

A Paper has been read to the Linnæan Society, by Mr. A. White, "On the Influence of Cold on the Flowering of Plants." After referring to the observations made by Mr. Curtis at a previous meeting, on the flowering of a plant under the snow, the author quoted from Captain Beechey's journal some remarks on the frequency of a prolific vegetation under the snow of Arctic regions. He referred especially to a plant called *Saxifraga nivalis,* which Linnæus stated flowered in the regions of eternal snow. He also made some remarks on the modification of the specific characters of insects and plants by a change of climate. Dr. Hooker stated that whilst at Terra del Fuego he had observed *Pernettya mucronata* in full bloom in a spot from whence the snow had been accidentally removed. Mr. Pratt, whilst at Chamouni, had in vain sought for plants that flowered under the snow, and regarded the circumstance referred to by Mr. Curtis as quite accidental.

VITALITY OF SEEDS.

DR. LANKESTER has read to the British Association, the "Twelfth Report of a Committee appointed to make Experiments on the Growth and Vitality of Seeds." The seeds set apart for the year's sowing were those collected in 1844. It was the third time the same seeds had been experimented on, and it was found that there was a very evident decrease in the numbers which have vegetated, compared with those of previous sowings. Dr. Lankester explained the object of the Committee, and stated, that the fact of raspberry seeds growing, which had been taken from the stomach of the body of a human being, buried in a tumulus in Dorsetshire, and which had been doubted, had been re-investigated during the past year, and there seemed no reason to doubt that the seeds, thus buried for centuries, had germinated.

Dr. Royle stated, that having been present when the original mass of matter from the stomach of the dead person was brought to Dr. Lindley in London, and the raspberry seeds discovered in it, he had no doubt of the correctness of the conclusion that the seeds which had thus been swallowed and buried, had germinated after the lapse of centuries.

IRISH PLANTS.

IN the department of Botany, some very valuable papers have been read to the British Association, by Prof. Dickie, with regard to the Geographical Distribution of Irish Plants. In the first, "On the Altitudinal Ranges of Plants in the North of Ireland," Dr. Dickie pointed out the remarkable fact that the range of Alpine plants is altogether lower in the north of Ireland than in corresponding latitudes in Scotland; and furthermore, that the range upon the north-west coast of Ireland is lower than upon the north and north-east coasts; so that the range of Alpine plants descends from Scotland, westward, for any given parallel. In the discussion which ensued, Prof. Arnott and the Prince of Canino drew attention to the importance of distinguishing between Alpine plants with a wet and those with a dry station, and Prof. Balfour showed that some Alpine plants descend very low in the western Highlands; but in the main Dr. Dickie's conclusions appeared to be borne out. In his second memoir, "On the Distribution of the Marine Algæ on the British and Irish Coasts, with reference to the probable influence of the Gulf-stream," Prof. Dickie stated that there is an anomaly in the marine vegetation of England which does not exist among the land plants. Algæ found in the south of England are also found in the Orkneys, but are altogether wanting in the intermediate points. This remarkable circumstance Dr. Dickie explained by the known influence of the Gulf-stream in rendering the mean temperature of the Orkneys higher than that of the coasts of Ireland and Scotland further south. Prof. E. Forbes brought forward evidence from the distribution of marine animals in favour of Dr. Dickie's view, and in *confirmation* of his facts. The Lusitanian Fauna, which extends

northwards round the western borders of Ireland, is absent in the Irish Channel, and upon the east and west coasts of Scotland and England, to which the influence of the warm current does not extend. Dr. Walker Arnott stated, in confirmation of the influence of the Gulf-stream, that large masses of North American *Ectocarpi* are frequently drifted on to the west coast of Scotland; and Prof. Owen drew the attention of lady collectors to the important service which they might render to hydrography by carefully collecting, noting, and preserving the sea-weeds of any place in which they might be resident.—*Literary Gazette*, No. 1860.

STRUCTURE OF RAPHIDES.

A PAPER upon this inquiry has been read to the Microscopical Society by Mr. Quekett. The author commenced by stating that inorganic substances were formed in plants under two circumstances. First, in crystals, as in the case of phosphate and oxalate of lime; second, as a portion of the tissue, as in the case of silica in the bark of equisetaceous and gramineous plants. The crystals were stellate or single, from the 1-40th to the 1-1000th of an inch in diameter. Single crystals of oxalate of lime were acicular,—those of the phosphate of lime were rhomboidal. Numerous plants were referred to in which raphides were found; as in the species of the cactus, the lime, the rhubarb, elm, apple, onion, and other plants. The author exhibited drawings of artificial raphides which had been found in the tissue of rice paper by the late Mr. Edwin Quekett, by immersing the cells first in lime water and afterwards in oxalic acid. In conclusion, the author gave a detailed account of some stellate raphides which he had found in great abundance in a species of cactus. On dissolving up the inorganic matter of these crystals by means of hydrochloric acid, he was surprised to find that an organic base was left perfectly similar in form to that of the crystal which had been dissolved. From this fact Mr. Quekett inferred that all these crystals were deposited with organic nature. He referred to the structure of calculi in the human and animal body, which were always deposited upon or with an organic base, as proof that this law was general, and that the deposition of inorganic salts in the tissues of plants and animals was always connected with the growth of organic matter. Dr. Lankester referred to the case of crystals in chara upon the surface of the plant, which seem to originate in cells in the same manner as hairs. Dr. Mantell inquired as to the mode of growth of the crystals in the interior of the cell.—*Athenæum, No.* 1304.

THE GENUS NOSTOC.

DR. JOSEPH HOOKER has read to the Linnæan Society a paper on the Genus Nostoc of botanists,—more especially on a species brought by Dr. Sutherland from the North Pole during the late Expedition in search of Sir John Franklin, under Capt. Penny. The plant was found in great abundance in the ocean, and resembled the *Nostoc commune* of botanists. It was in sufficient quantities to be used as diet; and Dr. Sutherland having eaten some of it, pronounced it

more agreeable and nutritious than the *Tripe de Roche.* Specimens of this plant had been sent to Mr. Berkeley; and from certain points in structure he considered it a new plant, and referred it provisionally to the genus Hormosiphon, under the name of *H. Arcticus.* Dr. Hooker also gave an account of a species of Nostoc which he had discovered in Thibet—and of another in China—which seemed identical with the one brought from the North Pole.

DEVELOPMENT OF THE SPORES OF FERNS.

A PAPER has been read to the Linnæan Society, from Mr. Henfrey, "On the Development of the Spores of Ferns." The inquiry went minutely into the structure and growth of the prothallium, antheridia, spermatozoids and archegonia, as the result of observations made on various species of ferns. The prothallium, which is the result of the growth of the spore, produces on various parts of its surface the antheridia and the archegonia,—the former being by far the more numerous. The spermatozoids are formed in cells contained in the antheridia. They consist of a flat band twisted twice or three times, and covered with long vibratile cilia. They escape from the antheridia by the bursting of this organ, and are to be seen upon the surface of the prothallium. The archegonium consists principally of a cell, like the embryo sac, which evidently becomes the young embryo. Mr. Henfrey denied that the spermatozoids entered the embryo sac; but inferred, without having observed any direct communication between the spermatozoids and the embryo sac, that the former were necessary to the growth and development of the embryo. A discussion followed, in which Mr. Bowerbank stated that he had not observed the spermatozoids to be so completely covered with cilia as those represented by Mr. Henfrey. It was probable there might be a difference in this respect in different species.

THE PALO DE VELAS OR CANDLE-TREE (PARMENTIERA CEREIFERA, SEEM.) BY M. BERTHOLD SEEMANN.

THIS tree is confined to the valley of the Chagres, where it forms entire forests. In entering them, a person might almost fancy himself transported into a chandler's shop. From all the stems and lower branches hang long cylindrical fruits, of a yellow wax colour, so much resembling a candle, as to have given rise to the popular appellation. The fruit is generally from two to three, but not unfrequently four, feet long, and an inch in diameter. The tree itself is about twenty-four feet high, with opposite trifoliated leaves and large white blossoms, which appear throughout the year, but are in greatest abundance during the rainy season. The *Palo de Velas* belongs to the natural order *Crescentraceæ,* and is a *Parmentiera,* of which genus hitherto only one species, the *P. edulis,* De Cand., was known to exist. The fruit of the latter, called *Quanhscilote,* is eaten by the Mexicans; while that of the former serves for food to numerous herds of cattle. Bullocks, especially, if fed with the fruit of this tree, Guinea-grass, and *Batatilla* (*Ipomœa brachypoda,* Benth.) soon get fat. It is generally admitted, however, that the meat par-

takes in some degree of the peculiar apple-like smell of the fruit; but this is by no means disagreeable, and easily prevented, if, for a few days previous to the killing of the animal, the food is changed. The tree produces its principal harvest during the dry season, when all the herbaceous vegetation is burned up; and on that account its cultivation in tropical countries is especially to be recommended.

CAMPHOR FROM BORNEO.

A COMMUNICATION has been read from Mr. J. Mottley of Labuan to the Linnean Society, accompanying specimens of Borneo Camphor and the trunk of the tree (*Dryabalanops camphora*) producing it. The Borneo camphor is consumed principally in China, where it is held in great esteem as a medicine. The best specimens realize as much as £5 per pound. An oil exudes from the tree which is also employed in medicine, and used as a varnish. The Borneo camphor is constantly mixed with the red seeds of a plant which are superstitiously added by the natives for the purpose of inducing the spirit of the camphor to remain,—who it is supposed would fly off unless some temptation of this kind were offered him to stay.—*Athenæum*, No. 1276.

THE SOAP-PLANT.

IT appears that the Soap Plant grows all over California. The leaves make their appearance about the middle of November, or about six weeks after the rainy season has fully set in; the plants never grow more than a foot high; and the leaves and stock drop entirely off in May, though the bulbs remain in the ground all the summer without decaying. The plant is used to wash with in all parts of the country, and by those who know its virtues it is preferred to the best of soap. The method of using it is merely to strip off the husk, dip the clothes into the water, and rub the bulb on them. It makes a thick lather, and smells not unlike brown soap.

THE GOLDEN PIPPIN.

THERE have been exhibited to the Horticultural Society, some interesting examples of the true old Golden Pippin, furnished by Earl de Grey's gardener, from Wrest Park, Beds. These had been grown on trees trained on an east wall, from which fine healthy crops are annually gathered; while from standards of this variety in the same garden, the fruit is cankered and bad; surely going far to prove that instead of the Golden Pippin wearing out, as some imagine, it is really too tender for our climate. A certificate of merit was awarded.

THE LENTIL.

THIS ancient vegetable so often mentioned in the Bible, so prolific, and above all, so nutritious, has been acclimatised by M. Guillerez, a French professor in Edinburgh, at great cost, and without any other reward than the gold medal of the Highland and

Agricultural Society. Whilst rolls of tobacco and starch have received prize medals from the Great Exhibition, a new food introduced into our country at the very moment when the potato seems to have lost its vitality, and threatens to disappear from the vegetable kingdom, as many plants have done before from exhaustion and overgrowth—the Lentil, that made an attractive article of the admirable collection exhibited by Messrs. Lawson and Son, as well as in a separate form, was passed unnoticed. In 1851, M. Guillerez for a fourth time, gathered 2½ bushels (167 lbs. weight) 5¾ lbs. only having been sown, and the rain in August having spoiled a great part of the crop, which was then budding. The lentils sown between rows of beans have produced, on an average, 30, 25, and one row even as much as 61, for 1; and, besides, he had a splendid crop of beans. Between the rows, propped by stakes, he had planted cabbage, cauliflower, salsify, beet-root, leeks, which all throve most beautifully. The lentils were so prolific that, if it had not been for the rain that damaged them to a great extent, they would have produced more than a hundred-fold. M. Guillerez tried a small spot as forage: he cut them twice, and they grew to the height of four feet. Here is a recipe for cooking lentils:—The plainest and best mode of preparing them is to steep them in cold water an hour or two; then to withdraw them, and place them in a goblet with enough of water to cover the surface, a little butter or a bone, some salt, and a little parsley. Place the whole on a slow fire. They must boil slowly, and you must take care to add water enough to keep the surface covered, but merely covered. You may boil them with ham, bacon, sausage, or merely with water and salt, to prepare them afterwards with onion *à la maître d'hôtel.* In schools, barracks, or large boarding establishments, they are often merely boiled in water and salt: then allowed to cool, and the water run off, and in which state you dress them with oil and vinegar, &c., like a French salad. When the lentil is bruised or ground into meal it makes an excellent "purée" with wild fowls or roasted game. It is prepared also like peas, for soups, dumplings. puddings, &c —*Journal of Agriculture, and the Transactions of the Highland and Agricultural Society of Scotland.*

THE POTATO ROT.

In March, 1851, the legislature of Massachusetts offered a premium of ten thousand dollars to any person within the Commonwealth who should satisfy the governor and his council that by a test of five years he had discovered a sure and practical remedy for the Potato Rot. Thereupon, a multitude of letters poured into the public office,—many of them containing valuable hints, facts or reasonings; —and the council ordered the secretary, Mr. Walker, to prepare a digest of the information placed at its disposal by the several correspondents. The conclusions to which all the facts of the case, as they are here gathered, have appeared to lead, are these five:—1. That the *disease* bears a striking resemblance to cholera, and probably exists in

the atmosphere. 2. That it is doubtful if any specific cure has been, or ever will be, discovered. 3. But, as in cholera, certain preventives are well ascertained, by the application of which the liabilities to disease may be greatly lessened. 4. That by obtaining the soundest seed, by planting the most favourable soils, and by using the most suitable manures, we may have a good degree of confidence in the successful cultivation of this useful vegetable. 5. That we may expect that, like the cholera, the potato rot will become less and less formidable every year, and eventually subside into a mild and manageable epidemic.

LEMONS GROWN IN THE OPEN AIR IN ENGLAND.

THERE has been exhibited to the Horticultural Society, a Dish of large fine-looking Lemons, of good quality, for which a certificate was awarded, was furnished by T. Lockyer, Esq., of South Wombury House, Plymouth, the interest about which is that they had been produced in the open air. It was stated that lemons had been cultivated against a south wall in Mr. Lockyer's garden for these last thirty years, the principal care required being merely to protect them from wet, from which they suffer more than from cold. This is readily effected by covering them in wet periods with straw protections or glass. It was stated that good dressings of sheep-droppings to their roots had kept them in a high state of luxuriance.

A NEW WATER WEED.

A CORRESPONDENT of the *Cambridge Chronicle* says, a remarkable plant has recently made its appearance in the rivers Ouse and Cam, and already abounds to such a degree as not only to impede navigation, but, what is of far more importance in this fen country, threatens to injure the drainage by holding up the water. It occurs in dense, tangled, submerged masses of considerable extent, and is so heavy that when cut (instead of rising to the surface and floating down to sea, like other water weeds), it sinks to the bottom. It is this property which is likely to make it injurious to drainage. The intruder is so unlike any other water plant that it may be at once recognised by its leaves growing in threes round a slender stringy-stem. The watermen on the river have already named it "water thyme," from a faint general resemblance which it bears to that plant. That it is new to the rivers is certain.

BLACK AND GREEN TEAS OF COMMERCE.

DR. ROYLE, in a paper on this subject, read to the British Association, observed, "it was a remarkable fact, that the difference between the Black and Green Teas had been, until recently, a matter of great uncertainty. The Jesuits, who had penetrated into China, and Mr. Pigou, were of opinion that both the black and green teas were produced from the same plant; while Mr. Reeve believed that they were manufactured from two distinct plants. Now he (Dr. Royle) had adopted the view that the best kinds of black and green tea were made *from different plants*; and examination of tea samples seemed

to confirm that view, but a repetition of the experiment had not done so. Mr. Fortune subsequent to the China war, having been sent out to China by the Horticultural Society of England, made inquiries on the subject. He there found the *thea bohea* in the southern parts of China employed for making black tea; and in proceeding as far north as Shanghae, he found the *thea viridis* used in making green tea near the districts where the best green tea was made. So far, therefore, the information obtained seemed to confirm the view of two different species of *thea* being employed to make the two different kinds of tea; but Mr. Fortune, in visiting the district of Fokien, was surprised to find what he conceived to be the true *thea viridis* employed in making *black* tea in districts near where the best black tea was made. He took plants with him from Fokien to Shanghae, and could find no difference between them. It was still, however, desirable to get specimens from the district where the black and green teas of commerce were actually made, and this had latterly been effected. In consequence of the great success which had attended the experimental culture of tea in the nurseries established in the Himalayas, Mr. Fortune was again sent to China by the East India Company. He proceeded to the northern parts of the country, in order to obtain tea seeds and plants of the best description, as the most likely to stand the Himalaya climate. Mr. Fortune procured seeds and plants in great numbers, and sent them to the Himalayas, where they had been since cultivated. When he had reached Calcutta, the tea manufacturers whom he had brought with him made from plants in the Botanic Gardens their black and green tea from the same specimens; so that it was evident it was the process of manufacture, and not the plant itself, that produced the green tea. All now who were acquainted with the difference between black and green teas knew that they could be prepared from the same plant without the assistance of any extraneous materials; though it was a common thing for manufacturers to use indigo, Prussian blue, turmeric, &c., in colouring the tea. Dr. Royle showed specimens of the Black Tea plant from the Woo-e-Shan, and of the Green Tea plant from the Hwuychou districts. No specific difference could be observed between the two specimens.

MICROSCOPIC ALGÆ AND FUNGI.

Prof. Allman has read to the British Association two memoirs upon the "Development of Microscopic Algæ and Fungi." It appears that in the process of steeping flax—during which a most abominable odour is given out—a minute cellular organism, closely resembling the yeast plant, is developed in very large quantities; taking on the form of a minute globule moving about actively by means of a vibratile tail, of a dichotomously-branched cellular frond, or of an elongated cellular filament. The odour given out appears to be principally due to the evolution of a peculiar chemical compound during the growth of the plant.

The other communication referred to a very peculiar alga which

colours large masses of water in very many of the ponds of Ireland. Its structure would be unintelligible without figures.

ALGÆ.

The following papers have been read to the British Association "On a Microscopic Algæ as a Cause of the Phenomenon of the Colouration of Large Masses of Water," by Prof. Allman. It appeared in little conglomerated gelatinous-like masses, and, when submitted to the microscope, it was found to consist of a number of fronds.—The younger fronds were nearly spherical, and consisted essentially of a central mass of transparent gelatinous matter, surrounded by a crust composed of minute cells, containing a green colouring substance. The crust being much slower in its growth than the internal nucleus, it soon bursts, and the nucleus then, by an apparent spontaneous action, assumed a regular form, not unlike an hour-glass, which soon separated into two distinct fronds. Some of them being put into a glass tube, and placed in the window, were observed to arrange themselves in a mass on the side of the tube opposite to that exposed to the sun's rays—that side of the mass towards the light being formed into a beautiful concave curve, which might, he thought, when fully investigated, reveal some important facts as to the nature and influence of light.

"On the Distribution of the Marine Algæ on the British and Irish Coasts, with reference to the (probable) Influence of the Gulf Stream," by Prof. Dickie. There were, he said, forms of marine Algæ generally admitted to be characteristic of our northern coasts, and others of the southern. The remarks he was about to make referred to those generally deemed of southern type; that is, those which usually are more or less abundant in low latitudes, and, on the other hand, are absent from high latitudes. Such species, natives of our coasts, may be classed under three heads: first, those confined to the southern parts of Great Britain and Ireland; second, species of more extensive range, since they extend to the north of Ireland and south-west of Scotland; third, those found abundantly in the South of England, and ranging along the western coasts of both islands, as far as Orkney and Shetland; and the species enumerated under these three classes, and amounting to more than twenty, are, so far as we can ascertain up to the present time, absent from a certain part of the east coast of Scotland. A considerable proportion of them reappear in Shetland and Orkney. The marine vegetation in these northern islands resembles that of the north of Ireland, though there is a difference between them of from four to five degrees of latitude. The marine plants of some of the north-eastern counties of Scotland, intermediate in latitude, are of more boreal character. The drifting of tropical fruits, &c., to the western and northern parts of Ireland and Britain, is a proof of the direction and presence of the Gulf stream,—the development of southern forms of algæ, at the extreme northern parts, is a proof of the same, and, moreover, seems an indication of its influence in reference to temperature. Are we to consider their absence from certain parts

of the east coast of North Britain as owing to a lower sea temperature than in localities where they exist? The portion of the coast in question is precisely that which, from the generally understood course of the Gulf stream, may be least exposed to its influence. Investigations respecting the temperature of our seas are, however, still desiderata, and without such, an important modifying element has been overlooked having reference to the climate of the British Islands.

Prof. E. Forbes said that the distribution of marine animals corresponded with those of marine plants. The same anomalies which Dr. Dickie had pointed out with regard to plants existed with regard to animals. Less attention had been given to the distribution of marine Algæ than almost any other organic existences. With the exception of the labours of Dr. Harvey, little or nothing has been done. We wanted a more accurate knowledge of the temperature of the ocean at different depths.—[This hint resulted in a subsequent recommendation from the Section that the Government would prosecute this inquiry.]—Prof. Walker Arnott said that he possessed waggon-loads of Algæ from all parts of the world, which were greatly at the service of any botanist who would work at them. The collecting part of the task had been done,—the naming and arranging were now alone necessary. Dr. Harvey could do no more than he had done at present.—*Athenæum*, No. 1299.

EDIBLE LICHEN.

A COLLECTION of Lichens and Mosses from Orilla, Canada West, has been exhibited to the Linnæan Society by Mr. Stevens. Amongst these were specimens of the *Tripe de Roche*,—a species of lichen belonging to the genus *Gyrophora*, which has obtained an interest from being eaten by the natives of Northern regions, and having formed the principal diet of a party of explorers in one of our earlier Arctic Expeditions.

ACRADENIA FRANKLINIÆ.

MR. R. KIPPIST has described to the Linnæan Society, *Acradenia*, a new genus of *Diosmeæ*. The genus is founded on a remarkable shrubby plant, with the opposite trifoliolate leaves and general aspect of a *Zieria*, discovered by Mr. J. Milligan, the Secretary of the Royal Society of Van Diemen's Land, in the neighbourhood of Macquarrie Harbour. It is characterized by the quinary arrangement of the calyx and corolla, by ten distinct and perfectly glabrous filaments, and especially by the structure of the five ovaries, which are closely combined, very villous, and each crowned by a large sessile gland or tubercle; the ovules are two in each cell, and pendulous. The species was named *A. Frankliniæ*, after Lady Franklin, who with her husband, Sir John, (at that time Governor of Van Diemen's Land,) were travelling in company with Mr. Milligan when he first met with the plant, in 1842, on the banks of the Franklin River. It has since been introduced to this country; and has flowered in the Royal Botanic Gardens, Kew.

Geology.

MAP OF SWITZERLAND.

SIR R. I. MURCHISON, in his Address at the Anniversary Meeting of the Geological Society, speaking of the progress made in the topographical survey of Switzerland, specially directed attention to four sheets of the Cantons of Appenzell and St. Gallen, which M. Ziegler of Winterthur has drawn and executed. They form part of a survey on the same large scale of 2½ inches to a mile, or 1-25,000th, which is also in the course of application to the cantons of Zurich and Schaffhausen. To give full effect to these four sheets only, M. Ziegler passed six consecutive summers in the mountains and valleys of St. Gallen and Appenzell, the geometrical measurements of which had been made under the direction of M. Eschmann. Sir Roderick considers them to be examples of a fidelity to nature which has rarely been attained. M. Ziegler soon found (M. Leopold von Buch and M. Escher von der Linth being his counsellors) that every class of rock has a peculiar "facies," and hence he became convinced, that no really good topography can be made by surveyors who neglect geological data. Thus, in these sheets, the eye of a geologist at once seizes the rugged escarpment of slaty rocks, the undulations of limestone, or the bosses of conglomerate or nagelflue; whilst, from personal inspection of a portion of the difficult region here represented, Sir Roderick adds, he never yet saw a map more completely ready to receive the colours of a field geologist. The lights are all thrown in perpendicularly, so that the defects of the maps of Geneva and Vaud, as proceeding from oblique shading, are avoided; and the altitude of each terrace, valley, or mountain top, is inserted in numbers on a most exquisitely-finished lithographic relief. M. Ziegler states, that, if the large scale of 2 8-10th inches to a mile had not been determined upon, he could have delineated as effectually all the same features on a scale of about 1¼ inch to a mile. In these works we perceive at a glance the value of good hill-shading; and when the map of the magnificent mountain of Sentis, which stands out to the low countries of Germany as the great sentinel of the Swiss Alps, is forwarded to us, you will see in it how perfectly such a work may supersede the want of any model whatever. The largest part of the cantons of the Grisons and of Tessin has been surveyed; but detailed maps of this mountainous region are still wanting, as well as those of large portions of Berne, which are constructed on the scale of the general Swiss map directed by General Dufour, or 64-100th inch to the mile. It is much to be regretted that the scale of these Swiss maps varies in different cantons. In the meantime, we are much indebted to M. Ziegler for a small, useful, general map of Switzerland, which he has published, and which will be soon coloured

geologically by Professor Studer of Berne, whose acquaintance with the structure of the Swiss Alps is more extensive than that of any other living geologist.

EXAMINATION OF ROCKS AND SOILS BY THE MICROSCOPE.

MANY years ago (says Professor Jameson) we strongly recommended the use of the Microscope in examining the Structure of Rocks, especially of quartz rock and sandstone; also of compact rocks, as basalt and clinkstone. Very lately this important subject has engaged the attention of naturalists, as at the meeting of the British Association at Ipswich in 1851, where a memoir was read on Klinology; and at the meeting of the British Association in the past year at Belfast, the Examination of Rocks by means of the Microscope was explained and illustrated in a very interesting manner by several of the more distinguished members of the Association.

The microscopic examination, by Ehrenberg, of the black earth or soil (Schwarzerde) of Tachermosem, in Russia, remarkable for its fertility, and which covers 60,000 geographical square miles of country, to a depth from half a yard to two yards and a half, is a fine example of the utility of microscopic examination of soils. This black earth was proved by examination to be a fresh-water deposit, and that, probably, its extraordinary fertility was in some degree connected with its abundance of microscopic fossil animals and plants, and their remains.—*Jameson's Journal*, No. 106.

DESOR ON THE DRIFT OF NORTH AMERICA.

THE Drift is the last phase of any importance through which the earth passed before it became fitted for the habitation of man. Were it not for these deposits, a great portion of this continent, including the district embraced in this Report, would have been a waste of naked and barren rocks, covered partially with heaps of dry sand, or rough detrital materials. Through the long-continued agency of water, these materials have not only been reduced and dispersed, but also mingled in such proportions as to afford a most appropriate soil for vegetable and animal life. When afterwards the rise of the continent caused the waters to recede within their present limits, they left behind them those wide drift-covered plains, destined to become, in the lapse of time, the seat of an industrious, intelligent, and prosperous nation. We think ourselves justified in considering the period when the waters, after having done their work, began to recede, as the beginning of that new and grand era which has been properly called the *Era* of Man, and of which the alluvial period is the introduction.—*American Journal of Science and Arts*, No. 37.

GEOLOGY OF THE DECCAN.

THERE has been read to the Geological Society a paper "On the Geology of the Country around Kotah, Deccan," by Dr. T. L. Bell. In this paper was given a geological description of the neighbourhood of the village of Kotah, on the Pranheetah River, in the Deccan,

and a detailed account of experimental borings in search for coal at that place. Obscure traces of vegetable remains, and some specimens of fish (*Lepidotus Deccanensis*), lately described in the *Quarterly Journal of the Geological Society*, and probably of oolitic age, are here found in bituminous shale; but no indications of the presence of coal have been met with.

GEOLOGY OF AUSTRALIA.

MR. BEETE JUKES, of the Geological Survey, has delivered at the Museum of Practical Geology, to a party of intending emigrants, a paper on the Geology of Australia, with especial reference to the Gold Regions. Mr. Jukes commenced by laying down a few general principles of Geology, so as to enable his audience to understand the nature of the country; and, in order to render his observations clearer, he exhibited diagramatic maps of Van Diemen's Land and Australia, consisting of Count Teleski's valuable geological sections, which are upon the scale of four inches to the mile; Sir Thomas Smith's map of Australia around Port Phillip; and Arrowsmith's map, showing the known places where gold has been found. In describing the interior of the country, travelling from Sydney, Mr. Jukes explained it as being greatly elevated; and, by means of a diagram, showed the exact scale of the height of the land to the Blue Mountains. These heights are broken into firm gullies and ravines, resembling grand gulfs left dry by the water. In many instances they are so numerous and complicated that they form a positive network of ravines, and it seems as if nature had been forming a maze for the purpose of puzzling mankind. The seaboard part of the country from Sydney southward to Port Phillip, after passing Cape Howard into Bass' Straits, presents a succession of great chains, running north; and, in other directions, plains which, in Australia, mean undulating land surrounded by rocks. Frequently, after traversing an open country, of scorching plains of sand and leafless woods, exposed to the heat of the sun, the emigrant suddenly comes to beds of the most clear and delicious water, and these lakes are the great natural baths for washing the gold that makes its way in veins from the granite or slate rocks by which they are surrounded; for it seems that it is only in granite, metamorphic, gneiss, mica, slate, and such rocks that auriferous drifts are found. Drift sand is more fertile in gold than rock, and the reason why auriferous gravel is richer in gold than the rock was explained by stating the weight of gold, which, being seven times as heavy as quartz, water, sweeping away the lighter portion, would carry away the rock and leave the gold. After detailing the physical structure of Australia at great length, Mr. Jukes addressed himself to the gold question, and briefly sketched the history of the discovery of the precious ore in that portion of the British empire. In 1834, Sir R. Murchison spoke with certainty of the existence of gold in Australia, a knowledge he had arrived at from his acquaintance of auriferous veins in the Blue mountains. This opinion he published in England. It was copied into one of the Sydney

papers, and a Mr. Smith was led to search for gold. He succeeded, and went to the Colonial Government with a specimen, but his application was put on one side, and nothing came of it. Subsequently to this, Mr. Hargraves, returning from California, and struck with the similar character of the rocks in Australia, and the country he had come from, searched for gold, and, aided by his Californian experience, was successful. Mr. Hargraves, like Mr. Smith, went to the Government; but, unlike that gentleman, the Government closed with him, and he received £500 down, the sum he had stipulated for, and an appointment besides. Mr. Jukes concluded his lecture by stating that digging for gold was hard work, as hard work as that of railway navigators and bricklayers—that it was incessant toil all day, lying hard at night, and with a total absence of all comforts, or at least what are considered such in this country; but he advised those who went out to Australia for the purpose of digging for gold, not to give it up as long as there remained to them the power of manual labour, health, strength, and resolution. At the same time he told them that digging for gold was like digging for anything else; and that, if they failed in finding the precious ore, not to be ashamed of putting their hands to something else—that in Australia there were hands wanted for ploughs, there were sheep to be sheared and cattle to be tended, and that they were as honourable occupations as digging for gold, and that industry and perseverance were sure to lead to fortune in Australia.

TERTIARY STRATA OF BELGIUM, AND THEIR ENGLISH EQUIVALENTS.

THE second part of this memoir,—"The Order Tertiaries," by Sir C. Lyell, V.P.G.S., has been read to the Geological Society. The Middle Eocene strata, or those older than the Limburg series, are well seen in the Hill of Cassel, near Dunkirk, and in some neighbouring hills, extending from French Flanders into Belgium. In these hills, the tops of which are capped by iron sandstone and sand, probably of the age of the crag of Diest, no fossils characteristic of the Limburg series have been discovered. Certain ferruginous and green sands, however, occurring next below the 'Diest crag,' have been referred to the Rupelian and Tongrian Systems of M. Dumont; but Sir Charles Lyell, having found near the middle of this group in Mont Noir casts of more than twenty shells of species common to the Calcaire grossier of France or the Bagshot and Bracklesham strata of England, concludes that a part of the group alluded to certainly belongs to the Middle Eocene division, and he questions the evidence of the rest being of newer date. Among the fossils are *Sanguinolaria Hollowaysii, Buccinum junceum, Turritella imbricataria, Natica patula, Cardium porulosum, C. semi-granulatum, Cytherea suberycinoides, Ostrea inflata,* &c. Below these, in the Hill of Cassel, are glauconites, containing in many parts *Nummulites variolarius;* and other fossils common to the Laeken beds near Brussels. The same nummulite accompanies the *Cerithium giganteum* near the bottom of this division at Cassel. Below the Laeken beds the *Nummulites lævigatus* abounds with *Cardita planicostata, Panopæa*

intermedia, &c. At Brussels three zones of the Middle Eocene may be recognised,—the highest called the "Laeken beds," abounding in *Nummulites variolarius;* the middle, or Brussels zone, in *N. lævigatus:* while the lowest is characterized by *N. planulatis;* each zone contains also numereus shells and other fossils, a fine collection of which has been made by Captain Le Hon. Below the sands through which nummulites can be traced, the "London clay" proper is met with at Cassel and Lille, from 150 to 300 feet in thickness. To the London clay succeed sands and clays with lignite, much resembling the plastic clay and sands of the London and Paris basins, and having the same average thickness. In this series, called the 'Upper Landenian' by M. Dumont, leaves of dicotyledonous trees and silicified wood occur. In the clay nearly in contact with the chalk at Carvin, near Lille, the *Cyprina Morrisii* abounds. At a still lower geological level, at Tournay, and near Mons, is seen a series of glauconites, which rest on different members of the cretaceous series, and to which the name of "Lower Landenian" has been assigned by M. Dumont. These Sir C. Lyell considers as older than any of the English tertiaries, and as partaking in some degree palæontologically of a cretaceous type. They have been called cretaceous by Baron Ryckholt, of Ghent. To the east of Brussels they overlie the Maestricht chalk, and are probably intermediate in age between it and the Thanet sands of Prestwich. This formation contains, near Tournay, a gigantic *Pleurotamaria* and *Ostrea lateralis* (Nilsson), which last passes downwards into a clay called *Verebratula rigida* (Sowerby,) a well-known chalk species. At Orp-le-Grand, Sir Charles found in this glauconite part of a large *Cardiaster*, recognised by Prof. E. Forbes, who remarks that this genus has been hitherto exclusively confined to the cretaceous epoch.

GEOLOGY OF KENT.

A PAPER has been read to the Geological Society, "On the soils that cover the Chalk of Kent," by J. Trimmer, Esq., F.G.S. The author commenced by pointing out the existence of a great variety of soils upon the chalk of Kent, and by referring to his already published opinion that these soils were formed by aqueous transport, and not by solution of the chalk *in situ*. As evidence of this view, and corroborative of conclusions he had arrived at when he lately gave an account of a section from near Hartley Parsonage, Kent, Mr. Trimmer described a section of the summit-level of the chalk between Farningham and Wrotham, about 700 feet above the sea-level, in which large "pot-holes" in the chalk were filled with alternating seams of sand, clay, and pebbles containing matter derived from the wreck of the chalk and the Eocene tertiaries; these alternations being covered by unconformable seams of similar composition. He pointed out also the characters by which "pot-holes" in the chalk belonging to the Eocene period may be distinguished from those of more recent date, such as were described in the present communication.

CARADOC SANDSTONE.

A PAPER has been read to the Geological Society, "On a proposed Separation of the Caradoc Sandstone into two distinct Groups, viz., 'May Hill Sandstone' and Caradoc Sandstone." By the Rev. Prof. Sedgwick, F.R.S. The author first gave in detail the evidence showing the existence—between Helmsgill, and Thornbeck, near Ingleton (a tract of about ten miles in length, where no traces of the Coniston limestone had previously been discovered)—of the three great Coniston groups:—1. (lowest) Limestone; 2. Flagstones; 3 Grits; surmounted by the Ireleth slate; which were treated of in the author's last communication to the Society. Prof. Sedgwick then alluded to his recent examination, in company with Prof. M'Coy, of some of the Malvern and May Hill sections; and stated his conviction that the shelly sandstones and grits immediately underlying the Woolhope (or lower Wenlock) limestone at Dursley Cross, west of May Hill, and forming the upper beds of the central dome of May Hill, are not to be regarded as "Caradoc," but as belonging to the Wenlock group; and he gives them the name of "May Hill sandstones." On palæontological grounds the author considers these beds to form the base of the Silurian series (Upper Silurian of Murchison); whilst the Cambrian (Lower Silurian of Murchison) commences with the Caradoc sandstone and Bala group; the faunas of these two great series, thus defined, being characteristically distinct. Similar conclusions were arrived at with respect to the purple sandstones, &c., under the Obelisk in Eastnor-park. The fossils from Howler's Heath also were found to confirm this opinion; and the inverted beds on the west flank of the Worcestershire Beacon afforded fossils of the same character as the "May Hill sandstones" above mentioned. The Professor regards the Coniston grits of Cambria, and the sandstones and conglomerates at the base of the Denbigh flags in North Wales, as the equivalents of the May Hill sandstone, and not the equivalents of the sandstones of Horderly and Caer Caradoc, as represented on the map of the Geological Survey. The paper concluded with some observations on the nomenclature of the Silurian and Cambrian rocks, British and foreign.—*Athenæum.*

PROGRESSIVE GEOLOGICAL DEVELOPMENT.

SIR CHARLES LYELL, in a lecture read at Ipswich, on Progressive Development, concluded by explaining the theory which he had advocated in his works, in opposition to that of progressive development. He believed that there had been a constant going out and coming in of species, and a continual change going on in the position of land and sea, accompanied by great fluctuation in climate; that there had been a constant adaptation of the vegetable and animal creations to those new geographical and climatal conditions. At the present moment we found contemporaneously a marsupial fauna in Australia, and mammalia of a different and higher grade in Asia and Europe; we also found birds without mammalia in New Zealand, reptiles without land quadrupeds in the Galapagos Archipelago, and land quadrupeds without reptiles in Greenland. In like manner,

in successive geological eras, certain classes, such as the reptiles, may have predominated over other vertebrata throughout wide areas; but there is no evidence that the adaptation of the fauna, as above explained, had been governed by any law of progressive development. In those classes of the invertebrata which were best known, and fully represented in a fossil state at all geological periods, the oldest or Silurian fauna was as highly developed as the corresponding fauna in the recent seas. Our ignorance of the inhabitants of the ancient lands was the chief cause of our scanty acquaintance with the highly-organized beings of remote epochs.—*Literary Gazette,* No. 1824.

COPPER-MINES OF LAKE SUPERIOR.

THE chief staple of Lake Superior is Native Copper. For ages before the appearance of Europeans in America, this metal was supplied from hence to the Indian nations far and near. The tumuli of the Mississippi, &c., contain the identical copper of this lake. Traces of ancient mining in Keweenaw, Ontonagon, and Isle Royale, are abundant, in the form of deep pits (a ladder in one), rubbish, stone mauls, hammers, wedges, and chisels of hardened copper. In a native excavation, near the river Ontonagon, with trees five hundred years old growing over it, lately lay a mass of pure copper 81 tons in weight, partly fused and resting on skids of black oak.

Modern explorers have hitherto only found two centres of metallic riches on the south coast,—that of Keweenaw and of Ontonagon. In the first are the valuable mines of the Cliff, North American, North-Western, and other companies. In the Ontonagon centre are the Minnesota and fifteen other mines.

At the Cliff mine three large steam-engines are employed (1852), with 250 men; and at the North American mine, two engines, with 160 men. Most of the other mines, forty in number, are assisted by steam-power. Three thousand mines are in work altogether, and the general population is fast increasing. Native copper is the principal object. Silver is always present, and occasionally in masses of considerable size. According to authentic accounts, dated February 1852, many new mines have been opened lately; and all are worked more systematically than heretofore,—generally by contract.

There are now in the Cliff mine masses of pure copper within view estimated to weigh 700 tons in the whole; and on the lands of the Minnesota Company, one block weighing 250 tons. The copper shipped in 1851 was about 1600 tons, valued at £130,000. This copper is stated to be of great excellence in the manufacture of wire, ordnance, and ship-sheathing.

The large beds of specular and magnetic iron-ore, on the south-east side of the lake, are as yet only worked on a small scale.

At this moment, the business of mining has ceased on the Canadian side of the lake. There is little doubt, however, but that profitable deposits will, sooner or later, be discovered here.—*Dr. Bigsby, in a paper read to the Royal Institution.*

SUPPOSITITIOUS SUBMARINE BRIDGE OF THE NORWEGIANS.

THE survey of the so-called long "sea-bridge" (Havbroe), which was supposed to range along the coast of Norway, is finished, and shows that the Jutland bank stretches west and north to about 61°, but is separated from the Norwegian bank by a channel nearly 200 fathoms deep; that the fishing-grounds between Stal and Christiansand are not so distant from the coast as was supposed, and are completely separated from the Jutland bank; and hence the tradition of the existence of a continuous submarine bridge between the coast of Norway and the Continent is a fable. These banks prove to be, in fact, as every geologist would *à priori* suppose, the representations, under the sea, of the detached "Osar" of the Swedes, and the "Skyærgaarden" of the Norwegians, as seen in the water-worn gravel ridges of the present continent of Scandinavia.—*Address at the Anniversary Meeting of the Royal Geographical Society,* 24*th May,* 1852. *By Sir R. I. Murchison.*

ROCK SALT OF THE PUNJAUB.

DR. ANDREW FLEMING, in the Medical Service of the Hon. East India Company, has ascertained the Geological position of the Salt in the North Punjaub to be below the carboniferous Limestone, in the form of a bed or beds. Geologists consider this discovery as one of great importance.—*Jameson's Journal,* No. 106.

THE GREAT ARTESIAN SALT SPRING AT KISSINGEN.

DR. GRANVILLE, in a letter to the *Times,* dated Kissingen Baths, July 8, 1852, completes* his description of this work, the boring of which had then reached the intended depth of 2000 feet, and was about to cease. A prospect-tower, 100 feet high, on a square acre of 900 feet, has been erected over the Artesian well; and there are five galleries around its interior for spectators to view the wonderful fountain.

Inspector Knorr, the eminent engineer of this work, has completed his contrivance for checking the flow of the jet, by means which he recommends to the attention of all hydraulic engineers engaged in like operations. This contrivance consists in forcing down the mouth of the bore, by means of suitable irons, and in the quickest manner possible, a bag containing clay. By getting wet, the clay becomes pasty and plastic, swells, and applies itself equally all round the sides of the bore, so as hermetically to stop, at pleasure, the ejection of the water.

On June 23, the visitors at Kissingen were invited to see the Artesian fountain at work, when the interior of the tower was crowded with spectators. At length, the inspector having given the signal, two workmen placed in the second gallery drew each a slender rope, by which the clay-bag frame was raised, when up shot a foaming column of water, which in one second of time by the

* *The first* public opening of this spring in 1850, is described in the *Year-Book of Facts,* 1851, *page* 35.

watch reached nearly to the roof of the tower, at an elevation of 76 feet, being 24 feet higher than it had risen on a previous occasion. The column, 15 inches in circumference, instead of 12 as formerly, was at first compact. It soon, however, split into a thousand perpendicular branches, gently curving outward, as they ascended, like graceful palm-leaves; and by the time it had reached its highest point it had formed a spreading head, like a weeping willow, as white as driven snow, and sparkling with diamond lustre.

It is calculated that the water is ejected (by the subjacent stratum of carbonic acid gas with a force of 200-horse power. The quantity of water thrown out is at the rate of from 96 to 100 cubic feet per minute, and with it there escapes simultaneously 110 cubic feet of the gas. The temperature of the water is 70 deg. of Fahrenheit. Its complete analysis has not yet been made, except as far as it concerns the presence of salt, which is the thing required. 58 rods, each 34 feet long, have been employed in the operation of boring, many of which are of wood of sufficient strength, and with the advantage of being lighter than the rest, which are of iron.

But the most ingenious part of Inspector Knorr's contrivances in this complicated, yet perfect work, remains to be described. The boring having discovered a bed of rocksalt at the depth of from 1740 to 2000 feet, with great reason for thinking that the stratum itself is not less than 1000 feet in thickness, the question which the inspector propounded to himself was, "How shall I avail myself of this abundant source of wealth and bring it to the surface? We have found at the depth of 1200 feet water with three per cent. of salt, which a subjacent stratum of 440 feet in depth of carbonic acid gas forces up out of the earth to a height of 76 feet, and this I can easily convey to the evaporating shades (*gradiren hausen*), in order to condense it, as in reality is now done. But if this water, after condensation, could be brought into contact with the rock-salt stratum below the gas, and then raised again to the surface, we might obtain water charged with nearly ten times the original quantity of salt, and thus add half a million of florins to the saline revenue of the Crown." And this problem Inspector Knorr has most successfully resolved, as the visitors at Kissingen had an opportunity of witnessing before the close of the season.

Three series of concentric tubes are sunk at various lengths into the bore, corresponding with the depths of salt-water strata to be dealt with. The largest, 5 inches in diameter, descends not lower than 330 feet, and serves to keep out all superficial waters of slender saline pretensions, as well as to maintain the sides of the bore or walls intact. The next concentric tube descends to 1740 feet, immersed in the water which lies over the rocksalt, and is 3 inches in diameter; while the third or innermost tube, 2 inches in diameter, descends to the depth of 1900 feet, immersed actually into the stratum of rocksalt. The united length of these tubes is 3970 feet. They are made of wrought plates of brass one-eighth of an inch thick, turned up, dovetailed at their edges, and soldered; and, having been subjected to a pressure of 50 atmospheres perpendicularly, and to that of

10,000 lb. weight longitudinally, they have resisted the forces without giving way. These tubes were manufactured by Klett, of Nuremberg, and are very creditable to the state of industrial art in that part of Germany. They cost 15,000 florins (£1250).

If we designate the largest tube by the letter A, the next by B, and the central by C, we shall be able to follow the practical operation by which Mr. Knorr has resolved his problem, simply remarking that the area of B and C is coequal, while that of A is larger.. It is through the latter that the water upheaved by the carbonic gas is ejected, and received at its fall in a suitable square basin or reservoir around the bore. Thence it is pumped by water-wheel pumps to the top of the *gradiren hausen*, which stand much higher, and extend to a considerable distance, as described at length in Dr. Granville's volume on Kissingen. By being made to fall from the top of these *hausen* several times through series of thorn-bushes, the water not only becomes concentrated to 9 per cent. of salt, but is likewise freed from all impurities. In this new condition the water has acquired the highest solvent power for acting on the rock-salt; and, accordingly, by means of a powerful horizontal hydraulic press, it is forced down the tube B till it reaches the region of the rock-salt, which it dissolves, charging itself with 27 per cent. of salt (that is, with 27 lb. of salt in every 100 pints of water), and then ascends through the innermost tube C, in virtue of the same pressure exerted continuously over the said tube B; and not only ascends to the surface, but even as high as 80 feet from the surface into a reservoir, whence, by a natural fall, it goes to feed the salt-pans in the boiling-houses for immediate crystallization; and the result is an exquisitely pure, white, and crystalline salt.

In conclusion, Dr. Granville observes that tube A, through which the water, with 3 per cent. of salt, is upheaved by the gas, will be in continuous action by day and by night to supply the requisite quantity of water for salt-making in the manner described; but that the *jet-d'eau*, which forms the admiration of all beholders, will only be allowed to take place now and then during the season, for the gratification of the numerous visitors to Kissingen.

THE GEYSERS OF CALIFORNIA.

Professor Forest Shepherd, in a communication to *Silliman's Journal*, gives the following account of some remarkable Geysers discovered by him north-west of the Nap Valley, California. "On the north, almost immediately at our feet, there opened an immense chasm, apparently formed by the rending of the mountains in a direction from west to east. The sun's rays had already penetrated into the narrow valley, and so lighted up the deep defile, that, from a distance of four or five miles, we distinctly saw clouds and dense columns of steam rapidly rising from the banks of the little river Pluton. It was now the 8th of February, the mountain peaks in the distance were covered with snow, while the valley at our feet wore the verdant garb of summer. It was with difficulty we could persuade ourselves that we were not looking down upon some manufac-

turing city, until, by a tortuous descent, we arrived at the spot where at once the secrets of the inner world opened upon our astonished senses. In the space of half a mile square we discovered from one to two hundred openings, through which the steam issued with violence, sending up columns of dense vapour to the height of one hundred and fifty to two hundred feet. The roar of the largest tubes would be heard for a mile or more, and the sharp hissing of the smaller ones is still ringing in my ears. Many of them would work spasmodically, precisely like high-pressure engines, throwing out occasional jets of steam, or volumes of hot scalding water, some twenty or thirty feet, endangering the lives of those who rashly ventured too near. In some places the steam and water come in contact so as to produce a constant '*jet d'eau*' or spouting fountain, with a dense cloud above the spray, affording vivid prismatic hues in the sunshine. Numerous cones are formed by the accumulation of various mineral salts and a deposit of sulphur crystals with earthy matter, which often harden into crusts of greater or less strength and thickness. Frequently the streams of boiling water would mount up to the top of the cones with violent ebullition. Some of the cones appear to be immense boiling caldrons, and you hear the lashing and foaming gyrations beneath your feet as you approach them. It is then a moment of intense interest—curiosity impels you forward—fear holds you back; and while you hesitate, the thin crust under your feet gives way, and you find yourself sinking into the fiery maelstrom below. The writer, on one occasion, heard the rushing water under his feet. He struck down an axe, which, on the first blow, went through into the deep whirlpool the whole length of the helve. He withdrew it, and cut an opening, which revealed a stream of angry water, boiling intensely, and of unknown breadth and depth. He continued to enlarge the opening until the stream was seen to be five or six feet in breadth, leading on indefinitely into the dark caverns beneath the mountains.

"At the base of the cones, in the bottom of the ravines, and in the bed and on the north bank of the river Pluton, springs almost innumerable break out, which are of various qualities and temperatures, from icy coldness up to the boiling point. You may here find sulphur water precisely similar to the celebrated *white sulphur* of Green Brier County, Va., except its icy coldness; also red, blue, and even black sulphur water, both cold and hot; also pure limpid hot water without any sulphur or chlorine salts, calcareous hot waters, magnesian chalybeate, &c., in an almost endless variety. Where the heated sulphuretted hydrogen gas is evolved, water appears to be suddenly formed, beautiful crystals of sulphur deposited, (not sublimed as by fire,) and more or less sulphuric acid generated. In some places the acid was found so strong as to turn black kid gloves almost immediately to a deep red. Where the heated gas escapes in the river Pluton, such is the amount of sulphur deposited, that the whole bed of the stream is made white for one or two miles below. Notwithstanding that the rocks and earth in many places are so hot as to burn your feet through the soles of your boots, there is yet no

appearance of a volcano in this extraordinary spot. Were the action to cease, it would be difficult, after a few years, to persuade men that it ever existed. There is no appearance of lava. You find yourself not in a solfatara, nor one of the salses, described by Humboldt. The rocks around you are rapidly dissolving under the powerful metamorphic action going on. Porphyry and jasper are transformed into a kind of potter's clay. Pseudotrappean and magnesian rocks are consumed much like wood in a slow fire, and go to form sulphate of magnesia and other products. Granite is rendered so soft that you may crush it between your fingers, and cut it as easily as bread unbaked. The feldspar appears to be converted partly into alum. In the meantime the boulders and angular fragments brought down the ravines and river by the floods are being cemented into a firm conglomerate, so that it is difficult to dislodge even a small pebble, the pebble itself sometimes breaking before the cementation yields.

"The thermal action on wood in this place is also highly interesting. In one mound I discovered the stump of a large tree, silicified; in another, a log changed to lignite or brown coal. Other fragments appeared midway between petrifaction and carbonization. In this connexion, finding some drops of a very dense fluid, and also highly refractive, I was led to believe that pure carbon might, under such circumstances, crystallize and form the diamond. Unfortunately for me, however, I lost the precious drop in attempting to secure it.

"A green tree cut down and obliquely inserted in one of the conical mounds, was so changed in thirty-six hours, that its species would not have been recognised, except from the portion projecting outside, around which beautiful crystals of sulphur had already formed.

"From the thermal exhalations and the amount of sulphur deposited, it might be supposed that the progress of vegetation would be retarded; but such is not the fact; on the contrary, it is greatly facilitated. The *Quercus sempervirens*, or evergreen oak, flourishes in beauty within fifty feet of the boiling and angry geysers. Maples and alders, from one to two feet in diameter, grow within twenty or thirty feet of the hottest steam pipes. This, however, may be accounted for by the cold surface water flowing down from the adjacent mountains. Multitudes of grizzly bears make their beds on the warm grounds. Panthers, deer, hares, and squirrels, also take up their winter quarters in the very midst of the geyser mounds. Farther down the stream, on the terraced banks of the limpid Pluton, vegetation *actually runs wild;* and the winter months exhibit all the fancied freshness of primeval Eden. I have traced the influence of this thermal action from two to three hundred miles on the Pacific coast in California, but only in this place have I been permitted to witness its astonishing intensity. The metamorphic action going on is, at this moment, effecting important changes in the structure and conformation of the rocky strata. It is not stationary, but apparently moving slowly eastward in the Pluton Valley."—*American Annual of Scientific Discovery*, for 1852.

NEW ERUPTION OF ETNA.

A MAGNIFICENT Eruption of Mount Etna, the first which has taken place since 1843, was witnessed on the 20th of August. The scene is described in the following letter addressed to the *Malta Mail*, by one of an English party about to ascend its cone just as the fires were vomited forth :—

Catinia, Aug. 22.—At 8 P.M. of the 20th August, a party of English, composed of Captain and Mrs. Hallett, two Misses Sankey, the Hon. Lieut. Finch, 68th Light Infantry, and Lieut. Ravenhill, Royal Engineers, with three guides, three muleteers, and a servant, together with eleven mules, left Nicolini, with an intention of ascending Mount Etna, and taking shelter at the Casa Inglese. At eleven o'clock, the party, in excellent spirits, reached the Bosco, where they put on their light clothing. The wind was blowing fresh from the westward.

Passing the Bosco about two miles, the huge crater below Etna, called the Colossi, glared awfully, and shortly threw up large bodies of fire and smoke. Immediately after, Etna vomited forth its fire and ashes, and as the wind set towards the Casa Inglese, it was not prudent to seek its friendly shelter, as in all probability it would be destroyed. Their course was therefore changed towards the Colossi.

The weather, which had been very cold, was increasing in its comfortless intensity, and when our travellers had got above the height of the Casa Inglese, in a narrow defile, of which sand and small lava were the component parts, they were overtaken by a hurricane so violently strong, that in an instant seven mules and their riders were blown over; and not only so, but to render the scene more terrific, it was afterwards found they were blown to the very edge of the crater.

At this time the scene was indescribably grand—heaven and earth presented one magnificent glare of light—Etna above vomiting its sulphuric flames—the Colossi below belching its dense masses of smoke, lurid from the furnace below—the huge mountain poured out from its interior prolonged moanings—without, the hurricane roared in all its awful majesty.

As if by magic the scene suddenly changed. An earthquake shook the ground—up jumped the guides, bawling their unmusical *Avanti, avanti!* ("Get on, get on.") Mules broke from their keepers, and were abandoned to their fate—the hurricane increased in strength—the scene around was too majestic for contemplation—too diversified for description. In ten minutes the little party had fallen from sheer exhaustion on the pointed lava. To face the wind charged with sand and small stone was beyond their power. In this manner two hours passed away, and most anxiously did they look for the approach of dawn.

Within the crater, which some of the party courageously examined, forty small furnaces were burning awfully; these, as they reached Catania, seemed to amalgamate, and one vast issue seemed to carry

destruction to some villages and pasture lands, which have been seriously injured.

The tourists now courageously started on their return, and reached Bosco at 7 A.M.; thence they continued their journey by mules, and reached Nicolini by 10 o'clock, whence they started for Catania, which they reached at 2.30 P.M.

Their safety, indeed, is miraculous, for had rain ensued, as often happens before an eruption, they would have been washed away; had the wind changed, they would have died under the sulphur-impregnated air.

The Eruption, however, continued.

A letter, dated Catania, August 30th, describes the lava at a gunshot distance: it moved slowly and uninterruptedly; the first waves rose and fell at the least obstacle they encountered; then sent forth streamlets, receded, extended themselves, and again advanced. Now it was heard as a continued sound of glass breaking in the fire, nothing more, and now immense damage succeeds.

By day all this grand mass presented an appearance between red and yellow, sometimes dull, sometimes brighter; by night the dull stream of fire, clouds of ashes, and sulphureous vapours were sublimely horrible.

The lava flowed over the richest and most cultivated part of the country, destroying vineyards, all sorts of fruit trees, and some houses.

Letters, to the 16th of September, stated the mountain to be still in active labour; and the course of the volcanic stream of liquid lava, which had branched off close to Zaffarana, had taken the direction of Milo, which seemed so assuredly doomed to destruction, that the inhabitants were clearing not only their houses, but likewise cutting down the lofty chestnut-trees in its vicinity, in the hopes of having time to remove the same to save the timber. A vast quantity of sal-ammonia was vomited from the crater, which rendered the air so impure as to threaten the lives of seamen in small craft trading along the coast. The deck of a small revenue steam cruiser had been nearly covered with volcanic cinders. Even as far as Malta, some of the soot and lava dust had been wafted by the wind during the night of the 21st of September.

An artistic Correspondent of the *Illustrated London News*, Oct. 9, who has furnished that journal with two effective sketches of the eruption, thus describes his visit:—

"On the 30th, we steamed on to a place called Resposto, a small town on the sea-shore, directly in a line with the centre of the mountain. Miles before we reached this spot, we could observe an immense mass of smoke, which, as we drew nearer, became as it were 'a thing of life,' wreathing about in black grandeur, and assuming a variety of rounded forms, amongst which forked lightning played incessantly, piercing the purple clouds which ascended high up into the blue sky, probably not less than 15,000 feet. Occasionally we caught a transient view of the whole outline of the mountain, and

then again it was veiled in clouds ever varying in form and colour.

"We commenced the ascent at 9 P.M., the night being rather dark for the first three or four miles. We passed along a bad road that wound about a deep rocky valley, which had lately been flooded. We next came to huge rocks, with signs of cultivation. The sea was now some miles behind us. A black sand was falling about like rain—it was perfectly dark. The ground occasionally trembled under our feet. Here most of the party halted, the greater number returning.

"We now caught a glimpse of the fiery volcano at the foot of a steep rugged hill, which took us an hour to scramble up. The whole grandeur of the eruption was at length before us. From a huge mass of the mountain issued broad sheets of fire in the form of swords; between which large lumps of red-hot rock occasionally were shot up into the air, and lost sight of in the masses of smoke above. On the left was a second crater, with two fiery mouths: and below, again, in a direct line, the earth opened in red-hot fissures. Far away, in the distance, we beheld the summit of Etna, the old crater quietly sleeping in moonlight. The earth thundered under our feet; black sand fell heavily about us. The scene was awful, yet fascinating.

"From the now larger crater a stream of molten lava, sixty feet wide, flowed down a rocky hill, and eventually formed a lake of fire; from which again two or three streams issued, the larger creeping on towards a small village, called Zaffarana. Whilst endeavouring to trace out the directions of the lava, we were suddenly surprised by a hurricane, and we all fell on the ground for safety. Fortunately there came a lull, and we all began again to make the best of our way down the mountain; morning dawned, but the sun did not change materially the aspect of the volcano. It continued to thunder; the fiery tongues shot through the black smoke; the sand fell in torrents; the clouds curled their giant forms; daylight could not penetrate their perpetual gloom. The whole party was like a group of sweeps when they reached Resposto."

A Correspondent of the *Athenæum* (Nov. 27), describes this eruption as the grandest and most terrible which has taken place for many years. The indications of the approaching activity of the mountain were, as usual, the drying up of wells in the neighbourhood, the duration of most dense clouds of white smoke which rose like a vast pine tree, hollow rumbling sounds, and three violent shocks, as of an earthquake. Shortly after, towards the east, two new mouths were opened in the site which is known under the name of the Valle del Leone. At first only clouds of a very fine ash were thrown up; which completely covered all the land near the mountain,—and quantities of which being taken up still higher by an impetuous wind, were carried far off into the sea. Immediately afterwards, an immense body of lava was vomited forth; which precipitating itself down the mountain with the violence of a torrent, divided into three streams. *One of these* flowed in the direction of Zaffarana—another

n the direction of the Comune of Giarra, more particularly on an estate called Milo, near Giarra. To give an idea of the immense quantity of liquid fire that was thrown out, official statements describe this river of lava as being two miles in breadth at the greatest, and ten palms in depth,—whilst the rapidity with which it moved was such as to cover in one hour a space of not less than 160 palms in extent. It seems, that in a very short time, in consequence of the increasing strength of the eruption, the new mouths were broken up so as to form one only;—from which masses of rock and cinder were thrown into the air to a great height, and falling on the wide extent of country round, carried with them the most fearful ruin. The utmost intensity of the eruption perhaps took place on the 25th, 29th, and 30th of August, and on the 4th of September. The rumbling subterraneous thunders were then incessant,—as was also the shaking of the ground, with clouds of smoke and flame which rested on the summit. On the 22nd of August the running lava is stated to have been 18 palms deep,—whilst on the 30th it had increased to 240 palms in some places. On the 31st of August the eruption still continued very violent. The lava advancing on the village of Ballo, completely swallowed up several houses on that day, as also the road which divides it from Zaffarana. During the next two days it diminished in power, and hopes were entertained that one or two neighbouring villages might be saved. On the 4th of September, however, it again burst forth with unusual fury—thundering—shaking—and vomiting forth new matter in the direction of Milo. Thus the mountain continued its activity with greater or less violence throughout the whole month. If the lava flowed in smaller quantity, denser clouds of smoke arose, and a greater quantity of ashes and sand were thrown out.

The damage, however, that has been inflicted on the poor inhabitants is a sad fact, which it is difficult to estimate:—for the course of the lava lay through a country of extraordinary fertility, and abounding in every species of vegetation.

A friend of the above Correspondent thus describes the Eruption: —"When we had gained the summit, the grandeur of the scene was such that no mind can conceive, no tongue describe. On our right, at about the distance of a quarter of a mile, and towering far above us, was an enormous hill of red-hot rock and half-molten lava, from which, at about our level, issued liquid lava, which descending in a stream of about 60 feet in width, precipitated itself into a lake of fire far below us. Facing us was a dark, stern-looking cliff, from which arose immense clouds of smoke and steam, of a deep reddish colour, to twice the height of the mountain,—and which, as the sheet and forked lightning played upon them, incessantly assumed a great variety of hues. At intervals, huge blocks of rock, some as large as a small cottage, and of a white heat, were projected high into the air with great violence, preceded and followed by thunder and deep rumblings, and accompanied by showers of steam and ashes. On our left, at about the distance of half a mile, and near the bottom of a very deep ravine, was another mass of fire, from which

issued a stream of lava. This also threw out large quantities of stone, accompanied by a loud hissing and crackling noise. Perhaps the depth of this ravine below us might have been 1000 feet.

The Eruption continued until towards the close of November, and then subsided until Dec. 9th, when it again burst forth. Accounts of the 14th and 15th state that violent detonations occurred from time to time, and that the lava increased daily. A shock of earthquake was experienced at Zaffarana on the 11th.

VOLCANIC ERUPTION IN THE SANDWICH ISLANDS.

In the *Polynesian* we find the following details of a late Eruption of this stupendous Volcano. By an accurate measurement of the enormous jet of glowing lava where it first broke forth on the side of Mauna Loa, it was ascertained to be 500 feet high. This was upon the supposition that it was 30 miles distant. We are of the opinion that it was at a greater distance—say from 40 to 60 miles. With a glass the play of this jet at night was distinctly observed, and a more sublime sight can scarcely be imagined. A column of molten lava, glowing with the most intense heat, and projected into the air to a distance of 500 feet, was a sight so rare, and at the same time so awfully grand, as to excite the most lively feelings of awe and admiration, even when viewed at a distance of 40 or 50 miles. The diameter of this jet is supposed to be over 100 feet. In some places this river is a mile wide, and in others more contracted. At some points it has filled up ravines of 100, 200, and 300 feet in depth, and still it flowed on. It entered a heavy forest, and the giant growth of centuries was cut down before it like grass before the mower's scythe. No obstacle can arrest it in its descent to the sea. Mounds are covered over, ravines are filled up, forests are destroyed, and the habitations of man are consumed like flax in the furnace. Truly, "He toucheth the hills, and they smoke." We have not yet heard of any destruction of life from the eruption; it was said that a small native village had been destroyed. Two vessels had sailed from Hilo, both filled to their utmost capacity with people who desired to witness this grand spectacle. The eruption seems to have broken out through an old fissure, about one-third down the Mauna Loa, on the north-west side, and not from the old crater on the summit called Mocquoweoweo. The altitude of the eruption was about 10,000 feet above the level of the sea, and from the bay of Hilo (Byron's Bay) some 50 or 60 miles. Had it succeeded in reaching the ocean at the point supposed, after having filled up all the ravines, gulches, and inequalities of a very broken country, it would undoubtedly have been one of the most extensive eruptions of modern times.

EARTHQUAKE IN MANILLA.

On the 16th of September, a fearful Earthquake was experienced in the island of Manilla. The first and most severe shock was felt about half-past six in the evening; when the narrator, who was seated at a window looking into the bay, describes everything to

have shaken so that he could scarcely stand, the earth rolling under him and the house creaking. The shock continued for about three minutes; from thence till about 11 at night there was a repetition of strokes. The roofs of two of the principal churches fell in with a tremendous crash, carrying with them the walls, and adjoining houses. The observer states, in a letter to the *Cork Constitution*:—In my opinion the cause of the earthquake was the fact of the volcano of Taal being closed for the last 100 years; but since the earthquake we were all again startled by a loud report like that of artillery, but which proved to be the opening of the crater of that mountain, which has since been in active operation. At one place, about 20 miles from Manilla, the earth opened several hundred feet in length, and about 18 inches wide, and threw up a considerable quantity of fine black sand, such as had never before been seen in the neighbourhood, which covered the ground to a great extent. Vessels coming to Manilla experienced the shock at sea, as if they had struck on a coral reef. A brig let go her anchor in deep water, and lost it, imagining she was on a reef. The shocks felt at sea were from 80 to 100 miles from Manilla, but not more than 10 or 15 from the main of Luzonia. The loss of life was limited to three or five persons. On the 12th of October we had another sharp shock, at about half-past five o'clock. I was awakened by my bedstead violently shaking under me, and quickly dressed and got out of the house. It lasted but a few minutes.

EARTHQUAKE IN WALES.

On the morning of Nov. 9, the neighbourhood of Carnarvon, and the greater portion of the mountainous district of North Wales, were visited by a more violent shock of Earthquake than has ever been known in the country. The whole of the previous day was exceedingly stormy, the wind blowing from the south-west with unremitting violence; but at the same time the atmosphere was so close, and the wind, though boisterous, so warm, that whoever had to walk any great distance became as much oppressed with heat as in the dog-days. After sunset the gale gradually decreased in violence, and was succeeded by a calm so unusual that a candle on the top of the town-wall burnt as steadily as if it had been on a drawing-room table. The air seemed to be surcharged with electric fluid to such an extent that the bells in many parts of the town kept up a vibratory motion, and produced that peculiar humming sound which is perceived after a bell has been violently rung and the pulsations of the clapper have ceased. Towards midnight, the air became almost stifling. About ten minutes past four in the morning of the 9th, the inhabitants were aroused by an extraordinary motion of their beds, and the breaking of crockery-ware. It was intensely dark; and although after a gale of wind the roar of the breakers on Carnarvon-bar is in a general way prolonged for many hours, yet on this morning not a murmur was heard, any *more than if I* had been miles away from the water, instead of being *close to its brink.* A most unearthly quiet brooded over sea and

land, broken, at length, by a sound more fearful than the most violent thunder. There were no premonitory perceptions of slighter shocks, as is frequently the case in earthquakes, but all at once a roaring, louder than breakers at sea or tempests on land could ever produce, was heard around, and continued for perhaps 20 or 30 seconds with undiminished power, and then gradually sank into perfect silence. The observer compares the noise to that of the passage of a brigade of fire engines at full gallop over the stones of a quiet London street. During the continuance of the sound, a powerful and continuous vibratory motion was perceptible; not like what is felt in many houses during a storm of wind, but a very peculiar tremulousness, which communicated itself to both animate and inanimate objects. The shock was felt, in a greater or less degree, over the whole county of Carnarvon, and over a great part of the island of Anglesey, and its greatest violence was felt in a line running south and north, commencing in the former direction at Carnarvon and in the adjacent mountains. In the latter district a farmer happened to be preparing to leave his house, and to him the trembling of the earth was so directly perceptible, that it appeared as if the soil would shake to pieces under his feet. The writer then compares the effect upon his system as similar to that produced by placing the hands on brass electrical conductors, which seem to cause every fibre in the system to be agitated. The only damage in the neighbourhood was the breaking of some glass and earthenware.—*Abridged from a Letter to the Times, by Mr. W. H. Baker, Academy, Carnarvon.*

EARTHQUAKE IN SCOTLAND.

On the morning of August 28, 1852, about a quarter-past five o'clock, Crieff, in Scotland, was visited with a shock of Earthquake. It was accompanied with a loud rumbling noise, like that of distant thunder. A great number of the inhabitants were roused from sleep. The sky was dark at the time, and not a breath of wind—not even a leaf moving. The ground was thickly covered with hoar-frost. The tremor of the earth was not great, and it lasted but a short time. It seemed to proceed from the south-west, and went towards the north-east, as it always has done in this locality.

EARTHQUAKE IN JAMAICA.

A severe shock of Earthquake, of longer duration than any since 1812, occurred in Jamaica, on the morning of the 7th July, but happily had occasioned no serious damage. It took place at half-past seven o'clock in the morning, and was preceded by a loud rumbling noise, similar to the distant rolling of carriages. Every house shook to its foundations, and in Spanish Town several old buildings were thrown down. All the clocks stopped immediately, and the shock of the convulsion was felt very sensibly by the crews of the ships in the harbour. The weather immediately after the earthquake became *excessively hot.*

EARTHQUAKE IN CUBA.

A VIOLENT Earthquake occurred last year in St. Jago de Cuba, and devastated great part of the place. Several public offices and stores were destroyed; and the new church and the cathedral were much injured. In fact, so destructive an earthquake has never before been felt in Cuba. In the street called Pases de la Marina the earth was broken up. In the house attached to the Exchequer-office there were two girls who escaped with only a few bruises about the body: they were taken out from amid the ruins. The shock was very sensibly felt by the persons on board the shipping in the harbour. The edifices attached to the Ignorada estate were all destroyed; fortunately there were no persons in them at the time.

EARTHQUAKE AT ACAPULCO.

ON the night of Dec. 4, Acapulco, in South America, was visited by a violent Earthquake. The ground rolled like the ocean in a swell, and then a trembling motion was felt lasting 30 seconds. About thirty of the best buildings in the town have been ruined, some falling completely, while all of any worth were seriously injured. Bottles, glass, and crockery-ware in the hotels and private houses were thrown from the shelves and tables. On the 8th, quite a severe shock was felt, throwing down a few wares which had partly fallen at the first shock. The Fulton Hotel fell at the first shock, but by almost a miracle every one was saved in the town. In fact, no life was lost, although a few persons were seriously injured. On Dec. 9, there were several shocks, and in the evening a volcano was seen in eruption at 60 miles from Acapulco. The weather previous to the earthquake was very sultry, with a clear sky and burning sun.

GEOLOGICAL MAP OF IRELAND.

MR. GRIFFITH has presented to the British Association a new edition of his Geological Map of Ireland, with the latest improvements and additions; the author at the same time giving a general sketch of the Geological Structure of Ireland. This is rather peculiar. It consists of a great central plain of limestone, having but little elevation above the sea, since Mr. Griffith stated the highest point of the railway between Dublin and Galway to be only 160 feet above it, surrounded in part by several groups of hills, consisting of older rock thrust up from below. There are five principal outbursts of granite in Ireland; namely, 1st, that of Wexford and Wicklow, piercing Silurian and Cambrian rocks, and altering them near their junction into mica slate and gneiss; the strike of this district is about north-east by north. 2nd, the Mourne Mountains in the south of the county Down, likewise penetrating into Silurian rocks, and altering them into gneiss and mica slate, and having a broad Silurian belt spreading round on the south, west, and north of them into the counties of Louth, Cavan, Monaghan, Armagh, and the rest of the county Down. The general strike of this district seems to be north-east by east. 3rd. The Mountains of Donegal, where the granite protrudes in great

force into a large mass of mica slate and gneiss, with much quartz rock and primary limestone, the exact age of these altered rocks not being yet known. They spread from Donegal, through Londonderry, into Tyrone, where granite again appears from under them in some places. The strike here is north-east. 4th, A north-east ridge of granite cutting through mica slate, and running from Mayo across Sligo, through Loughs Con and Cullen. 5th, The Galway granite district, running nearly east and west, with much mica slate, gneiss, quartz rock, and primary limestone on the north of it, on which reposes a mass of Silurian rocks very full of fossils.

In the south of Ireland no granite is seen; probably, this results rather from want of sufficient denudation than from other causes, as we have here some of the loftiest mountains of Ireland, consisting either of Silurian or of Devonian rocks, or of both, sharply bent and contorted, running in parallel ridges nearly due east and west, or at most east by north and west by south. Of these the most prominent are the Dingle promontory, of which Brandon Hill, 3,127 feet high, is the loftiest point; the Killarney promontory, where M'Gillicuddy's Reeks are 3,414 feet high, and the promontory between Kenmare and Bantry bays, where we have Hungry Hill, 2,153 feet high. Inland we have, still striking east and west, the Galtee Mountains, of which the highest is 3,015 feet; the Knockmealdowns, 2,609 feet; and the Comreghs, 2,597 feet. Some prominent hills of lesser height, and composed of Silurian and Old Red Sandstone rocks, likewise protrude in the counties of Clare, Tipperary, and Queen's County, through the carboniferous rocks, having no very definite strike and a quaquaversal dip. Around and between the districts thus indicated spread the horizontal beds of the mountain limestone, forming one great plain, the eminences of which consist, not of lower rocks thrust up from below, but of higher rocks reposing on the mountain limestone. On these the most important are the coal measures, which occur likewise in five principal districts of Ireland. The largest and most worthless of these is the coal-field stretching from Kerry, through Limerick, into Clare, the rocks consisting mostly of hard dark shale, with a few unimportant beds of culm. The next is the coal-field spreading through the counties of Tipperary, Kilkenny, and Queen's County, which contains some good beds of anthracite, formerly and still worked. The third is the Leitrim coal-field, and the fourth and fifth the coal-fields of Dungannon in Tyrone, and Ballycastle in county Antrim. In these are good beds of bituminous coals; but it is to be regretted, that in consequence of the great amount of denudation, the uppermost and most valuable beds are only left at a few small localities, having been worn away and swept off the remainder of the country over which they doubtless once extended. Over the remainder of Ireland there are no rocks newer than the coal-measures, but in Antrim we get some of the more modern rocks which were described on Monday, by Messrs. Bryce and M'Adam of Belfast. These rocks consist of some new red sandstone, and of parts of the lias, greensand, and chalk, overlaid by a great plateau of basalt, asso-

ciated with which were some tertiary clays and lignites. The new red sandstone forms a considerable district near Belfast, occupying great part of the valley of the Lagan. It consists apparently of the uppermost part of the formation, principally the red marls, which must, near Carrickfergus, be at least 800 feet thick, as Lord Downshire had sunk 750 feet in them, the lower 120 feet of which was in a magnificent bed of rock salt, the bottom of which was not yet reached. Below the marls are certain red and yellow sandstones of considerable thickness, but their base had not yet been ascertained, neither was it made quite clear whether any Permian rocks existed below it.

FOSSILS IN KILKENNY.

AT the late meeting of the British Association, a paper was read by Mr. Griffith "On the Lower Members of the Carboniferous Series of Ireland," followed by another by Mr. Jukes "On the Devonian Rock of the South of Ireland." Under these designations the authors appeared both to include certain beds, called also by Mr. Griffith "yellow sandstone," and "carboniferous slate," and the question was whether they belonged to the Carboniferous or Devonian systems. The paper, which is somewhat controversial, will be found in the *Literary Gazette*, No. 1862.

A portion of Mr. Jukes's paper was devoted to mentioning the precise geographical and geological locality of some remarkable Fossils discovered by the Survey during 1851. He stated they occurred in some alternations of red and green argillaceous sandstone at Kiltorkan Hill, near Knocktopher, county Kilkenny, about 500 feet below the base of the mountain limestone, and the same distance above the base of the old red sandstone, just where we would be inclined at that locality to draw the boundary between Upper and Lower Devonian. These fossils were then described by Professor E. Forbes, who said they consisted of some wonderfully fine ferns of at least two species; of some large shells which he believed were of the existing genus *Anodon* (our common freshwater mussel) though of course of different species; some species of Lepidodendron, and some curious cones; fish remains of Devonian types, and fragments of a crustacean called *Pterygotus*. The ferns belonged, he believed, to the genus *Cyclopteris*, and were entirely new species. Some of the fronds were upwards of two feet in length, and beautifully perfect. The Anodon he proposed to call *Anodon Jukesii*. The whole of the fossils he believed to be new, and to be of the greatest interest, as giving us the first clear evidence of the nature of the flora of the Devonian period, and as an indication of freshwater beds existing in that formation. On this point, Mr. Jukes mentioned that the comparatively thin and sandy character of the formation in Kilkenny, and its greater thickness and muddiness in the south-west of Cork, showed as if the one were formed near the shore, and the other *further out* in the deep sea.

PERMIAN FOSSILS IN IRELAND.

PROF. KING has read to the British Association a paper on some fossils said to be Permian, got from Cultra, on the south side of Belfast Lough, out of a magnesian limestone there. This limestone Mr. Griffith declared to be lower carboniferous, as it lay by, and, he believed, dipped under, some sandstone (part of his yellow sandstone), which from its fossils was certainly carboniferous. Other members believed this magnesian limestone to be resting unconformably upon the sandstone. This question is one of importance, especially with reference to the existence of coal, and its probable depth under the new red sandstone of Antrim; because if any Permian rocks can be proved to exist, the probable depth of coal beneath the surface at any locality will be greatly increased. On the upper surface of the red marls, which, beside the salt, contain strings and plates of gypsum, rest patches of lias, dark shale, with some calcareous bands, all containing fossils. The most remarkable circumstance connected with this lias is its extreme thinness. On the lias is some greensand equally thin, neither of them exceeding thirty feet in any case, and sometimes being only a few inches. On the greensand is chalk, with flints, likewise very thin, and over that is the basalt. Many very curious details of the relations of these rocks were given by Mr. Bryce, and also by Mr. M'Adam.

Mr. Salter, of the Government Geological Survey, read a paper, "On a few Genera of Irish Silurian Fossils," giving an account of some new Trilobites and Mollusca from several localities in Ireland. These will be found enumerated in the *Literary Gazette*, No. 1862.

RECENT GEOLOGY OF BELFAST.

MR. M'ADAM has described to the British Association, the way in which the site of the town of Belfast was formed of the silt of the rivers and brooks of the neighbourhood. The general tertiary, pleistocene, or "drift" geology of Ireland was entered on all these occasions, but discussed more at large in a paper by Mr. R. Young, "On the Eskars of the Central Part of Ireland." The coasts of the south-east and south of Ireland are fringed by a very recent formation, containing some living and some arctic species of shells. This formation consists of marls and sands, sometimes 100 feet thick, and spreading over considerable districts. It is found at intervals along the south coast, as far as Ballycotton Bay, in the county of Cork, and along the east coast as far north as Howth at least. The whole of the great plain of the centre of Ireland is covered by limestone gravel, which runs up into the flanks of the southern hills to the height of 600 or 800 feet; at all events piles and hills of this gravel occur indiscriminately, more or less mingled with sand; but Mr. Young discriminated between these irregular heaps and the regularly formed eskars, long lines or ridges of gravel running for many miles across the country like a road or winding railway embankment. In these he said the gravel would always be found sorted, the larger pebbles below. *However that may be*, he was, we think, right in attributing

their origin to the margins of opposing currents in a shallow sea.—*Literary Gazette*, No. 1862.

LOWEST FOSSILIFEROUS BEDS OF NORTH WALES.

MR. J. W. SALTER, of the Government School of Mines, has read to the British Association a paper on this subject. M. de Barrande having of late years shown that there was a peculiar group of fossils at the base of the Silurian system, designated by him group C, consisting in Bohemia of species of *Conocephalus, Agnostus, Paradoxides*, and other peculiar genera of Trilobites; and a similar fauna having been shown to occupy the same base line in Sweden, by M. Angelin, the object of the present communication is to exhibit the characteristic fossils of the lowest British strata, and to show that while they contain an assemblage very analogous to that of Sweden and Bohemia, they differ by the introduction of some other forms which appear to link them with the succeeding strata. The beds in question are the "Lingula flags" of Professor Sedgwick, and are largely developed at Ffestiniog, Dolgelly, and Snowdon; they are also found in the high range of hills over the slate quarries at Bangor, and they appear under another form in Shropshire. They lie at the base of the great igneous series, 15,000 feet thick, of which Cader Idris and Arenigfawr form part; occur still higher, interstratified with the porphyries, and probably terminate before the close of this series, as the upper porphyries are interstratified by beds containing fossils characteristic of the true "Llandeilo flags," or in M. de Barrande's language, the "Etage D."—For the details, see *Literary Gazette*, No. 1862.

WARWICKSHIRE FOSSILS.

A PAPER has been read to the Geological Society "On some Fossil Plants from the Lower Trias of Warwickshire," by Dr. G. Lloyd, F.G.S. The author, after referring to the scarcity of the remains of plants in the triassic rocks generally, and the rare occurrence of silicified portions of coniferous wood in the lower triassic beds in Warwickshire (at Allesley), announced the discovery of several casts and impressions of portions of the branches and leaves or plants or trees of large size in these beds at Merriden, about three miles north-west of the above-mentioned place. Of these the author assigns one form to the Conifers, under the appellation of *Breea cutassoides*, remarking that possibly the leaves under notice may be related to the fossil stems above mentioned. Another form is referred to the Algæ, and designated as the *Caulerpites oblonga*.

STRUCTURE OF THE IGUANODON.

ON March 5, Dr. Mantell, F.R.S., delivered at the Royal Institution a Lecture "On the Structure of the Iguanodon, and on the Fauna and Flora of the Wealden Formation." After a concise exposition of the characters of the various formations which have succeeded, and now overlie, or, in other words, are of more recent origin

than the Wealden—namely, the *drift* or diluvium, containing bones of large mammalia, as the mammoth, mastodon, rhinoceros, horse, deer, &c.;—the *eocene*, or ancient tertiary strata of the London basin, abounding in marine exuviæ of special and for the most part extinct types;—and the *cretaceous* or chalk-formation, comprising the white chalk of the North and South Downs, and the chalk-marl, galt, and greensand, of Surrey, Kent, and Sussex, the whole characterised by innumerable marine shells, zoophytes, fishes, reptiles, &c., of extinct species and genera;—Dr. Mantell proceeded to illustrate the structure of the Iguanodon as exemplified by the isolated parts of the skeleton hitherto discovered, and of which numerous examples were exhibited on the tables of the Institution. The perfect germ, and the unused tooth, of the Iguanodon, are characterised by the prismatic form of the crown, which is traversed on the thick enamelled face by three or four longitudinal ridges, and has the lateral margins denticulated, and the summit finely crenated; in this state the teeth resemble those of the living *Iguana* of the West Indies,—a resemblance which suggested the generic name of *Iguanodon*. But the fossil teeth are of enormous size in comparison with their recent prototypes; for the teeth of the Iguana are as small as those of the mouse, while those of the Iguanodon are often one inch wide, and three inches in length. Specimens exhibiting the above characters are, however, rare; the summit of the crown is usually more or less worn away by use, and the fang removed by absorption from the pressure induced by the upward growth of the successional teeth.

In the first example discovered by Dr. Mantell (in 1820), the crown was ground down so as to present on its inner face a smooth oblique surface with a cutting edge on the summit, and the marginal crenations were worn away; in this state the fossil so strikingly resembled an upper tooth of a rhinoceros, that Baron Cuvier pronounced it to belong to a species of that genus. Numerous teeth in different stages of growth and detrition were at length obtained, and the reptilian character of the animal to which they belonged was satisfactorily determined. Three years since, the first specimen of the lower jaw was discovered by Captain Lambart Brickenden, in the same quarry, in Tilgate Forest, from which the earliest known tooth was obtained; and subsequently a portion of the upper jaw with teeth has been procured from the Hastings strata. There are strong reasons for supposing that the lips in the Iguanodon were flexible, and in conjunction with the long fleshy prehensile tongue, were the chief instruments for seizing and cropping the leaves, branches, and fruit, which from the construction of the teeth we may infer constituted the food of the original.

The mechanism of the maxillary organs, as elucidated by recent discoveries, is thus in perfect harmony with the remarkable characters which rendered the first known teeth so enigmatical: and in the Wealden herbivorous reptile we have a solution of the problem, how the integrity of the type of organization peculiar to the class of cold-blooded vertebrata was maintained, and yet adapted, by simple modifications, to fulfil the conditions required by the economy of a

gigantic terrestrial reptile, destined to obtain support from vegetable substances: in like manner as the extinct colossal herbivorous Edentata, which flourished in South America countless ages after the country of the Iguanodon and its inhabitants had been swept from the face of the earth. The structure of the cervical, dorsal, and caudal vertebræ, of the ribs, the pectoral and pelvic arches, the sacrum formed of six anchylosed vertebræ, the bones of the extremities, and certain dermal appendages, were successively described, and illustrated by drawings and specimens.

From the facts adduced, Dr. Mantell infers that this stupendous reptile equalled in bulk the largest herbivorous mammalia, and was as massive in its proportions; for living exclusively on vegetables, the abdominal region must have been greatly developed. Its limbs were of proportionate size and strength, to support and move so enormous a carcass; its length, as proved by recent discoveries, was of crocodilian proportions, for there is no doubt that the tail was very long; and the largest Iguanodon may have attained a length of from fifty to sixty feet. The *Hylæosaurus Megalosaurus*, and several other genera of reptiles, were severally noticed, and reference made to the specimens in the British Museum. The lecturer then took a rapid view of the other reptiles that were contemporary with the Iguanodon, enumerating the *Pterodactyles* or flying lizards, and several genera of Crocodilians and Chelonians.

Examples of marine and fresh-water turtles are not uncommon in the Wealden deposits; and the strata near Swanage have furnished many beautiful specimens to the researches of Mr. Bowerbank. Of Fishes there are nearly forty known species in the Wealden, which are chiefly referable to the *Ganoid* and *Placoid* orders. The fishes most abundant in the rivers of the Iguanodon country were two or three species of *Lepidotus*,—ganoids closely allied to the *Bony* or *Gar-pike* of America; their teeth and scales are everywhere to be met with in the Tilgate strata. The Invertebrate Fauna comprised many genera of insects, a few Crustaceans, and numerous fresh-water Mollusca. The Insects (for a knowledge of which we are mainly indebted to the scientific acumen of the Rev. P. Brodie) amount to several hundred specimens, comprising between thirty and forty families or genera, and are referable, for the most part, to the orders *Coleoptera, Orthoptera, Neuroptera, Hemiptera.* and *Diptera.*

Among them are several kinds of beetles, dragon-flies, crickets, May-flies, and other familiar forms which are closely allied to species that inhabit temperate climates.—*Mollusca.* The most numerous shells belong to the genera *Cyclas* and *Paludina;* of the latter, which is a genus of fresh-water snails, there are a few species that abound in the Wealden clays and Purbeck beds, and form extensive strata of shelly limestone, the compact masses of which are susceptible of a good polish, and are well known by the names of Sussex, Petworth, and Purbeck marble; the latter was in great request in the mediæval ages, and is the material of which numerous tombs and monuments, and cluster columns in our ancient cathedrals, are constructed. Two common inhabitants of our pools and streams, the *Planorbis* and

Limnæus, also occur. Several species of *Unio*, some of which rival in magnitude the pearl-mussels of the Ohio and Mississippi, likewise abound in the Wealden deposits. Fresh-water Entomostraceans, *Cyprides*, of several species, swarm in many of the clays and ironstone beds of Sussex and the Isle of Wight.

The flora of the country of the Iguanodon appears to have been as rich and diversified as the fauna. Forests of *Coniferæ*, referable or closely allied to *Abies*, *Pinus*, *Araucaria*, *Cupressus*, and *Juniperus*, clothed its hills and plains: with these were associated arborescent and herbaceous Ferns, comprising upwards of thirty species; together with many *Cycadeaceæ*, and trees allied to the *Dracæna*, *Yucca*, &c. Equistaceous and Lycopodiaceous plants also abounded; and even the common inhabitants of our streams, the *Charæ*, flourished in the rivulets of that marvellous region. As examples of the vegetation of the Wealden period, Dr. Mantell described the petrified forest of coniferæ and cycadeæ in the Isle of Portland: the accumulation of fossil firs and pines exposed on the southern shore of the Isle of Wight; and the coal-field of Hanover, which entirely consists of the carbonized foliage, trunks, and branches of coniferous trees, drifted from the country of the Iguanodon.

The facts thus rapidly noticed prove that during the deposition of the Wealden, Oolitic, and Cretaceous strata, there existed an extensive island or continent, diversified by hills and valleys, and traversed by streams and rivers teeming with fishes, crustaceans, and mollusca, closely allied to types which at present inhabit the fresh water of temperate regions; and that with these were associated fluviatile turtles, and crocodilian reptiles, whose living analogues are restricted to tropical climes. Colossal herbivorous and carnivorous saurians, differing essentially in structure from all known existing forms, were the principal inhabitants of the dry land; and these, together with flying lizards, and possibly a few birds, and very small mammalia, constituted the vertebrate fauna of the country, or countries, which supplied the materials of the Wealden strata, and of the fluvio-marine deposits which are intercalated with the purely oceanic beds of the oolite and chalk. Thus it appears, according to the present state of our knowledge, that the classes mammalia and aves, which constitute the essential features of the terrestrial zoology of most countries, were represented through a period of incalculable duration solely by two genera of very diminutive mammals, and a few birds; while the air, the land, and the waters, swarmed with peculiar reptilian forms, fitted for aërial, terrestrial, and aquatic existence.

Admitting to the fullest extent the effect of causes that may be supposed to have occasioned the absence of mammalian remains in the secondary deposits, yet the immense preponderance of the reptile tribes is unquestionable. Some authors have attempted to account for this anomaly by assuming that antecedently to the eocene period, our planet was not adapted for the existence of mammalia, in consequence of its atmosphere being too impure to support higher types of animal organization than the cold-blooded vertebrata. But the certainty that *some forms* of marsupial and placental mammalia inhabited

the countries of the Megalosaurus and Pterodactyle,—that birds in all probability existed with the Iguanodon,—and the fact that insects and mollusca, and trees and plants, which now inhabit regions abounding in birds and mammalia, flourished during the "Age of Reptiles,"—demonstrate that the physical conditions of the earth, and the constitution of the atmosphere and of the waters, differed in no essential respect from those which now prevail, and that the laws which govern the organic and inorganic kingdoms of nature have undergone no change. That the class Reptilia was developed during the periods embraced in this disclosure to an extent far beyond what has since taken place appears to be indisputable; nor can any satisfactory solution of the problem be offered from the data hitherto obtained.

Future discoveries may however show that coeval with the country of the Iguanodon there were regions tenanted by birds and mammalia; and that the almost exclusively reptilian fauna of the lands whose zoological and botanical characters have formed the subject of this lecture, was but an exaggerated condition of that state of the animal kingdom which is exhibited by the present fauna of the Galapagos Islands. In conclusion Dr. Mantell alluded to the recent discovery of reptilian remains in the Old Red Sandstone of Morayshire, in proof of the necessity of bearing in mind the salutary caution of Sir Charles Lyell, "that as our acquaintance with the living creation of past ages must depend in a great degree on what we term chance, we ought never to assume that the first creation of any type of animals or plants took place at the precise point where our retrospective knowledge happens to stop."—*Literary Gazette*, No. 1839.

REPTILIAN REMAINS FOUND IN THE OLD RED SANDSTONE OF MORAYSHIRE.

ON the coast of Morayshire, between the villages of Covesea and Burghead, strata of crystalline sandstone occur in great thickness, and are regarded as belonging to the upper division of the Old Red or Devonian formation of Scotland. The only fossil discovered in this rock was the imprint of a mass of scales or scutes of a remarkable ganoid fish, named *Stagonolepis* by M. Agassiz, until 1850, when Captain Brinkenden, F.G.S., observed on a block of sandstone, in a quarry at Cummingstone, a distinct series of quadrupedal footprints, traced in an uninterrupted succession across the slab. The imprints are thirty-four in number, and the track of the right feet alternates with that of the left. These impressions have a rounded form, and are identical with those which are generally regarded as chelonian footprints by palæontologists. In October 1851, from a quarry of sandstone at Spynie Hill, Mr. Patrick Duff, of Elgin, obtained a beautiful imprint of the skeleton of a four-footed reptile, about five or six inches in length, and which that gentleman allowed the author to transmit to Dr. Mantell to describe, as an appendix to the present communication. The author states that, on finding the chelonian foot-tracks in rocks of an age in which no traces of the *class Reptilia* had previously been discovered, a strict investigation

took place as to whether the sandstone strata, from which the slab was taken, are unquestionably referable to the Devonian formation, to which they had always been supposed, by Mr. Hugh Miller and other competent observers, to belong. The discovery of the reptile at Spynie dispelled all doubt on this point; for the beds of Cummingstone and Spynie are identical, and, at the latter place, are capped by the Cherty limestone peculiar to the upper division of the old red of the district. The *Stagonolepis*, found in the same rocks, is emphatically an old red sandstone family of fishes, and confirms the above inferences. The author concludes with the remark, that by the discovery of the chelonian footsteps and the reptile of Spynie, we have thus for the first time obtained unquestionable evidence that two orders of the class *Reptilia* existed during the Devonian epoch.

The reptile from Spynie, referred to by Captain Brickenden in the foregoing paper, consists of the impression of the skeleton in a block of sandstone, which is broken into three pieces. The cranium is but obscurely seen. Of the rest of the skeleton scarcely an atom of the osseous substance remains. The impression of the spinal column from the occiput to the pelvis, consisting of twenty-four vertebræ, each supporting a pair of slender ribs, of the left humerus, radius, and ulna, of the femoral and leg bones, of the pelvis, and of a considerabie portion of the caudal series of vertebræ, serve to convey a general idea of the form and structure of the original. Mr. Patrick Duff describes its anatomical characters, so far as they can be ascertained from the imperfect state of the specimen, and the result of a comparison with recent forms. He specifies certain osteological characters which are *Lacertian,* and others that are *Batrachian;* and he concludes that the original was a peculiar type, which, in the present state of our knowledge, it would be rash to pronounce to belong to either order; and he distinguishes it by a name simply expressive of its high antiquity—*Telerpeton* (τηλε ἑρπετον), with the specific term *Elginense,* to denote the locality in which it was discovered. The original was an air-breathing, oviparous quadruped, probably resembling in appearance an aquatic salamander, but with longer limbs and a wider dorsal region than our Tritons, and capable of rapid progression on land and in the water. In connexion with the above discoveries, the author states that the Devonian shales of Forfarshire abound with clusters of small, round, carbonaceous bodies, which are commonly associated with aquatic plants. These fossils have been figured and described as being probably ova of gasteropodous molluscs, although neither shells nor casts of shells of any kind have been found in the strata. The discovery of reptiles in the upper member of the Old Red of Scotland led Dr. Mantell to recur to an idea he formerly entertained, that the Forfarshire fossils were the spawn of Batrachians of the family Ranidæ; and upon comparing them with a mass of carbonized recent frogs' eggs, the resemblance was found to be so complete as to induce him to conclude that the fossil eggs are referable to reptiles and not to molluscs. In conclusion, the author dwells on the importance of the researches of Cap-

tain Brickenden and Mr. Duff in a palæontological point of view; for they establish the existence during the Devonian or Old Red epoch of several orders of a higher class of vertebrate animals than had previously been discovered; while the occurrence of Batrachian ova with aquatic plants, associated with remains of ganoid fishes, which, for aught that is known to the contrary, may have been inhabitants of fresh water, like the existing *Lepidostei*, together with the entire absence of marine organisms, suggests the probability that the Devonian strata thus characterized may be of fluviatile origin.—*Jameson's Journal*, 104.

SILURIAN FOSSILS, AND MOUNTAINS OF SCOTLAND.

At the late meeting of the British Association were read two papers—"On the Fossils of the Lower Silurian Rocks of Scotland," by Mr. Harkness; and "On the Structure of the South Silurian Mountains of Scotland," by Professor Nicol. The first of these gave a description of the geology of Dumfries-shire; the second described the whole of that belt of Silurian rocks which stretches across the Lammermoor Hills, in a south-west direction, through the south of Scotland, to Dumfries; and appear likewise to strike into Ireland in County Down. The fossils described consisted entirely of graptolites, of which there were several species. Both authors coincided as to the vast thickness to be assigned to the rocks, exceeding 30,000 feet, after making every possible allowance. Professor Nicol described the structure of the whole district succinctly, bringing the section into considerable harmony with that of North Wales, described by Messrs. Jukes and Selwyn. He noted the entire absence of slaty cleavage, and compared the strike of some parts of the district with that of some of the systems of M. E. de Beaumont. He also discussed the nature of the antidinal and syndinal curves, with reference to some proposed theories in physical geology, but did not arrive at any decided result.—*Literary Gazette*, No. 1862.

THE DIAMOND.

Sir David Brewster has read to the British Association an interesting paper on the Diamond, in which he detailed some experiments recently made by him on the Koh-i-noor and other diamonds, in London. The result of these experiments and observations was Sir David's belief that a diamond was nothing else than a fossil germ. Many diamonds had cavities exhibiting fibres or rings of polarized light, such as could only have been produced by the expansive force of a gas or fluid acting in the cavity when the diamond was in a soft state. He also had an amorphous diamond on the outside of another diamond, answering to the cavity withinside it, and had no doubt the one had emerged from the other in a fluid state, and crystallised instantaneously. He likewise described a black diamond—black, not in its substance, but from the number of cavities it contained; and Sir David mentioned a similar diamond cut by a Dutchman into two,

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·e it were found many hundred weights of
·h adipocere.—*Ibid.*

ƆLD DISCOVERIES.

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the history of their development, and how they became wh
now are; thirdly, it must inquire into their habitat, their ext
and their natural conditions. The author observed, that al
it might be difficult to answer many of these questions with
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looked in the accurate investigation of the animals and plants
present world. After pointing out the other duties of palæon
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phenomena were explained by such mysterious terms as *lu turæ, nixus formativus, vis plastica*, &c., he concluded by ob
that the study of the oldest fossiliferous deposits, the pa
formation, was now everywhere most actively carried on, ar
the difficulties attending it were proportionately great; it po
nevertheless a peculiar charm, inasmuch as it dealt with tl
creatures which inhabited our planet, and to a certain degr
the origin of organic life on the earth, and attempted to unra
organization of the oldest forms of life. In this respect, the
provinces, a great portion of Nassau, the Eifel, and Westphal
tributed no small contingent to the fauna and flora of the pa
age. He concluded with the remark of Alexander von Hu
respecting the importance of the science. "Palæontolog
searches have, as with an animating breath, given grace and
to the study of the solid structures of the earth."—*Literary*
No. 1863.

FOSSIL HUMAN TEETH.

DR. KURR, of Stuttgardt, has read to the German Associat
the Advancement of Science, a paper on Fossil Human Teeth
author commenced by raising the following questions:—1. Ca
be any fossil human teeth? 2. Are the teeth produced human
tooth in question was found in the clay containing pirolitic i
on the summit of the plateau of the Suabian Alps in Würte
filling up hollows in the Jura limestone. No doubt was ente
as to the tooth being a human tooth, but the chairman stat
he was not satisfied that it might not belong to a postdiluvial
—*Literary Gazette*, No. 1865.

RECENT DEPOSIT OF SULPHUR.

DR. ZIMMERMAN, of Hamburgh, has read to the German A
tion for the Advancement of Science, a communication "On a
Deposit of Sulphur near Hamburgh." In the construction of
sewer, the workmen were so overpowered by sulphuretted hy
gas, that they were at times unable to continue their work.
found on examination to proceed from a soil saturated with s
and gypsum. It was ascertained, on further inquiry, that the
was artificial, and that on the spot some thousands of pira
been massacred and buried by the citizens of Hamburgh. T
phur was the result of the decomposition of their bodies actin

the sulphate of lime in contact with the matter discharged from the sewers. Immediately above it were found many hundred weights of human bones, and also much adipocere.—*Ibid.*

GOLD DISCOVERIES.

In the *Year-Book of Facts*, 1852, pp. 266—271, will be found a minute account of the Discovery of Gold in various districts of Australia; and the discoveries have been extensively increased during the past year. The mere enumeration of the localities would occupy more space than we can devote to such details; and we prefer selecting a few of the more remarkable discoveries, given in detail.

"By far the richest deposit," says Lieutenant-Governor Latrobe, in his despatch to the Colonial Secretary, Oct. 10, 1851, "is found in the small veins of blue clay which lie almost above the so-called 'pipe-clay,' in which no trace of the ore has been discovered. The ore is to all appearance quite pure. It is found occasionally in rolled or water-worn irregular lumps, varying from a quarter of an ounce to one or two ounces in weight, sometimes incorporated with round pebbles of quartz, which appears to have formed its original matrix; at other times, without any admixture whatever, in irregular, rounded, or smooth pieces, and again in fused irregular masses of pure metal of great beauty, weighing, in some instances, seven or nine ounces. It is also found combined with quartz, pebbles, or gravel of various sizes, evidently united to them while in a fused state, and on the surface of the detached masses of iron sandstone, but in the greatest abundance in the clays, from which it is washed in the form of rounded or flattened grains, like sifted gravel and sand of various sizes; though frequently interspersed with larger pieces, either pure or combined with quartz. The seams of the auriferous blue clay are found most irregular in their deposit, and seldom more than 4 or 5 inches in thickness. They appear, disappear, and break off and thin out continually. The washing of two tin dishes of this clay, of about 20 inches in diameter, has been known to yield 8 pounds weight of pure gold; and two or at most three cubic inches of the same has yielded 4 ounces."

In his despatch of December 3, 1851, the Lieutenant-Governor describes the discovery of pure gold, not only *under* the surface, but in many instances *upon* the very surface, requiring but little or no labour to collect: and enormous gains are made in many instances after a few days' or even hours' labour. In his next despatch, Dec. 19, Mr. Latrobe says: "The gold raised upon the Mount Alexander gold field, is now calculated by hundred weights, and arrives in the cities at the rate of probably two tons per week. A pound weight of gold a day is but a small remuneration for a party of diggers; many secure five or six; and there are instances of fifty being the result of but a few hours' labour. Large quantities have likewise been scraped from the very surface.

"At a very late date, the weekly produce of one gold district, 70 *miles from Melbourne*, was near 100,000 ounces, equivalent to

£20,000,000 a year; and at a moderate estimate, the whole yearly produce of Australia would not be less than £40,000,000."

Advices from Port Philip (Victoria) to September 2nd, give one week's total, brought by escort, at 105,000 ounces. The total exported to England, from the date of the first discoveries to July 31st, was 1,265,000 ounces, or about £5,000,000 from Victoria; while from New South Wales, up to August 14, it was £2,007,012, at the colonial price of 65s. per ounce, or about £2,500,000 actual value. A further total of not less than £1,000,000 had been forwarded also from Victoria to Adelaide, South Australia. The people from Adelaide were universally the most successful, owing to their previous familiarity with mining pursuits; and one party is known to have realized £6000 in a single morning. New deposits were constantly announced; Koorong, about thirty miles from Bendigo, and Anderson's Creek, near Melbourne, being among the most prolific spots.

In South Australia, a very extensive gold-field has been discovered about 15 miles from Adelaide to the south-east, where most of the experiments on the surface were satisfactory.

On November 23, 1852, three vessels arrived in the Thames from Australia, with upwards of seven tons of gold on board. One of the ships, the *Eagle*, was freighted with the largest amount of the precious metal ever known to arrive in one vessel, namely 150,000 ounces (upwards of six tons) and of the value of more than £600,000 The other ships were the *Sapphire* from Sydney, with 14,688 ounces on board; and the *Pelham*, from Sydney, with 27,762 ounces.

In January, 1853, the *Australian* steamer arrived in England with a large cargo of gold; including the Victoria nugget of 328 ounces of the purest gold, presented by the government of the colony to Her Majesty. This nugget was found at the Bendigo diggings, between 3 and 4 feet below the surface.

In 1852, taking the most moderate estimates, the entire produce of gold reached £43,000,000; being an increase over 1846, of £30,637,323, and over 1850, of £15,557,212 sterling.

The produce of California alone, from the commencement of mining operations in 1848 to June 30, 1852, is computed by parties on the spot to amount to £34,956,175 sterling.—*See Stirling, On the Gold Discoveries, and their probable consequences.*

Gold has also been found at Manukan, in New Zealand; in Van Dieman's Land; and in Canada West. And, quartz with gold is stated to have been found at Moor river, in the colony of Natal.

LOCAL CHANGES ON THE SOUTH-EASTERN COAST OF ENGLAND.

A PAPER "On the Alluvial Formations and the Local Changes of the South-Eastern Coast of England, from Beachy-Head to Scotland," has been read to the Institution of Civil Engineers, by Mr. J. B. Redman. Westward of Beachy Head the effects produced by local variations in the beach were traced,—the "fulls" tailing across the outfall of Cuckmere Haven, and driving the outlet eastward, creating a barrier of beach at Seaford,—at an early period the outfall of Newhaven Harbour,—where an ancient outlet existed on the site of the present entrance, subsequently projected eastward by the

passage of shingle from the westward, until rendered permanent by piers. The recent degradation of the shore along Seaford Bay, from the shingle being arrested to the westward, and the unavailing attempt to stop this movement by blasting the cliff at Seaford Head, were noticed. The waste of the coast at Rottingdean, the modern changes at Brighton, the great variations in the outlet of Shoreham Harbour, until rendered permanent by artificial works, were examined, as well as the analogous effects on the coast generally at Pagham, across the entrance of which a spit had been formed, similar to those at the ancient harbours of Romney and Pevensey, and the anchorage of the Park, off Selsey Bill, once presumed to have been a portion of the site of a Bishop's see, prior to its removal to Chichester, owing to the progressive waste of the shore. At the back of the Isle of Wight, the peculiarities of the land-locked harbours, and the protection afforded by the shore defences to Portsmouth harbour, so little altered in its general outline since the time of Henry the Eighth, were described, as also the remarkable promontory called Hurst Point, many of the characteristics of which were similar to those of the Chesil Bank, Calshot Point, and other formations, such as a low flat shore to leeward (eastward) and a highly inclined beach seaward, with a tendency to curve round to the northward and eastward, and eventually to enclose a tidal mere, or estuary. The elevation and size of the pebbles increased towards the extremity of these points, and in places on the sea slope an intermixture of coarse sand and shingle, which had become solid and homogeneous by age, cropped out through the modern beach. The remaining portion of the coast of Hampshire, and that of Dorsetshire, as far as Weymouth, were then minutely described, and the paper concluded with a particular account of the Chesil Bank, which in magnitude far exceeded all other formations of the kind, and which it was considered might be attributed to the waste of the great West Bay. Numerous diagrams, compiled from ancient and modern maps, together with sections and sketches of the various alluvial spits along the coast, were exhibited, and it was shown that all these local accumulations had many features in common, and were subject to the same alternating effects of loss and gain, and were the resultant of causes in constant operation, the whole exercising a most important influence on harbour and marine engineering generally. —In the discussion which ensued, in which Sir C. Lyell, Sir E. Belcher, Mr. Rennie, Capt. O'Brien, Mr. Scott Russell, and the author took part, the peculiarities of the different parts of the coast were still further described, and the formation of the moles of shingle were attributed by some of the speakers to the action of the tidal currents, but more generally by others to the mechanical power of the waves alone, which appeared to account for the apparent anomalous fact, that the largest pebbles were always found on the summit and to the leeward. Chesil, Hurst, and Dungeness beaches were referred to, as remarkable instances of results produced by such causes; and the effect of the severe storm of the 24th of November, 1824, on the base of Hurst Beach was alluded to.

Meteorological and Astronomical Phenomena.

PHENOMENA OF 1852.

DR. FORSTER, the able meteorologist, observes, in the *Brussels Herald*:—The winter of 1851-52 had been very mild, and many of the spring plants were in flower early in February, but their progress was checked by cold, and we had a late spring, the thermometer showing below the mean temperature accompanied by heavy rains till near Midsummer, when the hot weather set in with alternations of violent showers, which only differed from wet summers in this, that the heaviest fall of rain did not break down the temperature. On the 25th June, the thermometer stood at 80 degrees till night, and the heat remained 5 degrees above the mean during the whole summer. From July the 4th to the 15th, the temperature rose to from 88 deg. to 90 deg. every day at 2 P.M., with considerable fluctuations of the barometer, the changes of wind chiefly from S.E. to S.W. not in the least affecting the instrument. The showery weather increased through August and September with hot and clear intervals. What is very strange, the temperature descended below the mean during October, but rose again suddenly towards November, so that on the 2nd of the month the heat was as high as 70 degrees of Fahrenheit, a thing quite unprecedented at this season of the year in Belgium; the whole month was rainy, but notwithstanding the heavy fall of water, no considerable diminution of temperature took place till the 1st of December, when the first frost set in with a heavy white fog. During the whole summer the positive electricity of the air has prevailed; a few sudden changes to the negative, preceding some of the showers, always seemed to cause illness. Instead of the annual meteors being confined to the 10th August and the 13th November as usual, falling stars prevailed more or less the whole of the latter part of the summer till September; some on August 9th, 10th, and 11th were very brilliant. The swallows left us early, the swift *hirundo apus* about the 31st July, the house-martin and swallow at Michaelmas. The *Aurora Borealis* appeared frequently in October and November, occasioning a wide diffusion of reddish luminosity which shone through the thinly clouded sky at night. It is remarkable, that although we have had none of the destructive floods which have been so disastrous in England, there has always been a cotemporary depression of the barometer in Belgium, and an oppression and unhealthy feeling in the air, producing headaches, with lightning and thunder on some occasions.

CYCLE OF THE WEATHER.

THE authority for a paragraph of "Statistics of Hot Summers," which has appeared in *Galignani's* Messenger, has been traced to the

Weather Cycle, clearly enunciated so far back as the year 1817 by Lieut. George Mackenzie, of Perth, who, in 1821, received, through Baron Seguier and the late Sir John Sinclair, the thanks of the Royal Academy of Sciences in France, conveyed by their then perpetual secretary, M. de Lambré, for his "System of the Weather in the British Islands;" and from that day to this, in all Mackenzie's numerous publications—the latest of his writings on this subject being dated so recently as the 25th of June last—an uniform consistency has prevailed, and his cyclical discovery has been confirmed beyond all cavil. On the occasion of which we speak, M. de Lambré informed the author that the Academy had referred his work to the Baron de Humboldt, and the attentive reader of the learned baron's "Cosmos" will see the principle of the Weather Cycle, discovered by Mackenzie, distinctly recognised. We consider it due to the author of the *Cycle* to mention this fact; because, somehow, the study and importance of his discovery, as well as his ceaseless, expensive, and unassisted efforts to enlighten the public on the subject of it, have been singularly overlooked in this age of scientific progress. Not only, however, does the "Cycle of the weather" prove the recurrence of such great quadrennial periods as at present prevail, and which of themselves are confirmatory of the periodicity of certain descriptions of weather, but no doubt whatever now exists that the intermediate annual, biennial, and triennial periods are as clearly distinguished by their own peculiar features, and which can be as readily forecast. The importance of the discovery consists—not in a mere retrospective register of the phenomena of any season or series of years—but in the certainty of the repetition of such phenomena at future stated periods. It is further proved that these alternations are as regular and perpetual as the alternations of winter and summer, or of day and night, and all the other immutable revolutions in the order of nature. In all probability, during the approaching winter or spring, we shall have some curious recorder of "coincidences" exercising his retrospective talent on the "Statistics of Floods;" for the construction of the cycle leads us to anticipate such a visitation.—Abridged from the *Church and State Gazette*, 1852. (The writer's anticipations were generally realized up to Jan. 22, 1853.)

METEOROLOGICAL OBSERVATORY OF MOUNT VESUVIUS.

THE Meteorological Observatory recently erected at Mount Vesuvius, was projected by Prof. Melloni, so well known to all the world by his memorable researches on heat, and the most distinguished of all the Italian physicists. The king of Naples gave the enterprise his sanction, and furnished the means to construct the building. The house is of ample dimensions, standing on an artificial terrace at the summit of the hill of ashes which forms the limit of the arable regions of Vesuvius, and at an elevation of about 2000 feet. The centre has three floors above the basement, and the two wings each one floor above the basement; in the rear and joining the main building is a round tower, and the roofs are conveniently arranged for meteorological purposes. All the plans were furnished by Prof.

Melloni, who also superintended its erection, which by an inscription of the exterior appears to have been begun in 1841.

Unfortunately for science, the revolution of 1848 entirely arrested the further progress of the undertaking; the house stands vacant, no instruments are provided, and worst of all, Prof. Melloni has been removed, not only from his direction in the Observatory, but also from his Professorship in the University, under the caprice of a despot who knows no law but his own will, and who has shown in this act that he was unworthy of so noble a subject.—*Silliman's Journal*, September, 1851.

COLUMN OF LIGHT.

A PERPENDICULAR Column of Light was seen in the horizon, at sunset, in April. A Sussex observer describes it to have been singularly vivid, and faded gradually away, or rather followed the sun. Mr. R. I. Martin, of Pulborough, writes in the *Philosophical Magazine:* "It had none of the character of the zodiacal light, but rather looked like the columnar prolongation of the sun described by oriental travellers as frequent in the east; and it immediately suggested to my mind (as it seems to have done to some of the above-mentioned observers) the columnar light in Martin's 'Exodus,' the 'pillar of fire' moving before the Israelitish host."

TEMPERATURE OF CORNWALLIS ISLAND.

MR. GLAISHER, the Secretary of the Meteorological Society, has drawn its attention to some additional results he has deduced from the hourly thermometrical observations made by Admiral Sir John Ross and Commodore Philips, at Cornwallis Island, latitude 74° 40′, west longitude 94° 16′. These observations were made hourly, night and day, and extended from the 1st of October, 1850, to the 30th of April, 1851, from which Mr. Glaisher has determined the mean temperature of every day, that of each month, and that of every hour in each month. The frequency of large changes of temperature was remarkable. The 21st of March was mentioned as having been a most remarkable day; the range of temperature on this day was between—28° and 43°, its average was—36°·8; the wind was from the north-west, and blowing for the most part with pressure at times amounting to 20lb. on the square foot, its average for the whole day being fully 15lb. on the square foot; and Mr. Glaisher remarked that he was previously under the impression that at such low temperatures the air never moved with so great velocity.

METEOROLOGY OF IRELAND.

DR. LLOYD has read to the British Association, a paper "On the Meteorology of Ireland," deduced from observations made at the coast-guard stations under the direction of the Royal Irish Academy. The isothermal lines for the various seasons are very peculiar in Ireland: for example, the isothermal for spring lies nearly from south-west to north-east; and in autumn it is found to have veered round

and taken up a position from south-east to north-west. The ingenuity of the explanation given by Dr. Lloyd for this enigmatical phenomenon is remarkably striking. Looking at the maps of Dove, the isothermal line is sometimes observed to bend suddenly upward or downward, thus forming a kind of hill or prominence on the general line of direction. Now these bends are not stationary; and one that occurs near Ireland has a motion to the westward. Imagine the bend thus moving; its western slope must first cross the island, and this slope, which is present in spring, has a south-easterly direction; continuing to move, the eastern slope of the curve cuts the island in autumn, and hence the isothermal in this case must have a north-westerly direction. At the inland stations it is observed that the ranges of temperature for the day and year are greater than at the coast. It would lend additional interest to such observations as those so ably conducted by Dr. Lloyd, if the nature of the soil and strata surrounding a station were noted. Ranges of temperature in Ireland will depend almost solely upon these causes; the high specific heat and low conducting power of water preserve the stations on the coast from those sudden fluctuations to which strata of comparatively good conducting power are exposed. The mean temperature of the western coast of Ireland exceeds that of the eastern by about two degrees. The mean elastic force of vapour in Ireland during 1851, was equal to the pressure of 0·314 of an inch of mercury. The influence of local causes in modifying the quantity of rain was strikingly exhibited. Thus, at Cahirciveen, the quantity which falls is nearly three times that which falls at Portarlington. The mountain of Slieve-bloom rises to the south-west of the latter town, arrests the vapours, and discharges them in rain before they reach it; Cahirciveen, on the contrary, lies on that side of a mountain which exposes it to the discharge of the clouds from the west. The observations of Dr. Lloyd also furnish evidence of the existence of rotatory air-currents; observations made simultaneously at various stations prove that these aërial rotations are not confined to the hurricane, but may be traced in the motions of the gentlest breeze.

DETECTION OF OZONE IN THE ATMOSPHERE.

DR. MOFFATT has presented to the Meteorological Society several interesting records, showing the test papers he has used for the purpose of detecting the quantity of Ozone in the Atmosphere at different times.

FALL OF RAIN.

COL. SYKES has communicated to the British Association an Analysis of the Mean Daily Temperatures and Fall of Rain at 127 Stations in the Bengal Presidency. These observations afford striking illustrations of the influence of hills and other local and physical causes on the fall of rain, owing to which the difference in the quantities of rain collected at two different stations in the same latitude, and not

many miles apart, was often very great. At some stations the enormous quantity of 600 inches was observed in a single year. Col. Sykes also read extracts from a letter from Dr. Buist on four simultaneous experiments in the island of Bombay, to determine the fall of rain at different heights below 200 feet. The results of these observations were indecisive; but from the discussion which followed it appeared an established fact, that up to a certain height the quantity of rain increased, attained a maximum, and afterwards decreased. Dr. Buist also dwelt upon the numerous exceptions to the admitted rule, that the annual range of the barometer increased, and the diurnal fluctuations decreased, as we recede from the equator. In reference to the communication of Col. Sykes, Sir David Brewster showed the influence which the times chosen for observation would have upon the results—without regard to this, indeed, the observations might be utterly worthless. There are two hours in the day at which the temperature is a mean of the day; the first occurs in these countries at about 9 o'clock A.M., and the last at about 8 hours 15 minutes P.M.; the critical interval, as it is called, being thus about 11 hours 15 minutes. It was of the greatest importance to ascertain whether this interval were the same in India, where the circumstances were so very different.

GREAT FALL OF RAIN IN INDIA.

PROF. OLDHAM, in writing to Sir R. I. Murchison from Churra Poonjee, in the Khassya Hills, north of Calcutta, states that the Rainfall is there about 600 inches, or 8½ fathoms, per annum; 550 inches of which descend in the six rainy months commencing in May; and that in one day he measured a fall of 25·5 inches.

ANNUAL AMOUNT OF RAIN AT ALEXANDRIA.

THE annual amount of Rain at Alexandria stands in contrast to that mentioned as occurring in some places in India; the quantity at the former being only 7¼ inches. This quantity, indeed, might be expected to be small, from our knowledge of the fact that three or four degrees to the south the country is nearly rainless.—*Jameson's Journal*, No. 106.

TROPICAL HURRICANES.

DR. J. TAYLOR has read to the British Association, a paper on Tropical Hurricanes, stating the circumstances which give rise to them, and proposing the following theories of them—viz., that the partial vacuum indicated by the low state of the barometer over the area of the storm and particularly towards the vortex, is not the effect of centrifugal force, but the original cause of the movement, by inducing a translation of air from beyond the boundary of the partial vacuum inward towards its centre,—a motion which would occur in directly converging right lines were the earth and air at rest; but the earth being in motion, and therefore the area of the hurricane turning round with regard to its own centre, the velocity of such movement

being greater for a particle of air at a distance from that centre than for one nearer,—as the particles approach it they retain their greater velocities, and thus move, not in radial lines, but in diminishing circles or spirals round the centre. The author then traced the consequences of such combined motions, by supposing the disturbance to commence first around one of the poles of the earth, and then by tracing the change of circumstances which must take place in other latitudes; and asserted, that by calculating by these suppositions, using as data the well-ascertained dimensions of the area over which cyclones extended, a relative movement of the air over the earth, even greater than had ever been observed in violent hurricanes, might result. He concluded by showing how an experiment which he had prepared might be performed, so as to exhibit the more striking effects of a hurricane in water, by giving a whirling motion to a wide vessel of water furnished with a valve in the bottom, at a distance from the axis, which could be withdrawn. He also stated his conviction, that the phenomena of sea and land breezes would yet be found to partake of the rotatory character.

ROTATORY THEORY OF STORMS.

MR. R. RUSSELL has communicated to the British Association, a paper "On the Action of those Storms to which the Rotatory Theory has been usually applied," the object being to point out certain difficulties of a theoretic nature if we admit the rotatory and at the same time progressive motion of those storms; and also to show, by comparison with observations, that the rotatory theory was not reconcilable with certain storms of the British Islands.

SHEET LIGHTNING.

THE frequency of this phenomenon during the summer and autumn of the past year, induces us to quote the following description of the meteor by Dr. D. P. Thompson:—"There is an electric phenomenon of peculiar character, termed sheet or summer lightning (*éclairs de chaleur*), unaccompanied by thunder, or too distant to be heard. When it appears, the whole sky, but particularly the horizon, is suddenly illuminated with a flickering flash. Matteucci supposes that it is produced either during evaporation, or evolved (according to Pouillet's theory) in the process of vegetation, or generated by chemical action in the great laboratory of nature, the earth, and accumulated in the lower strata of the air in consequence of the ground being then an imperfect conductor. Arago and Kämtz have adopted a very different view of the nature of these lightnings, considering them as reflections of distant thunder-storms; and the author has often observed thunder-storms preceded and followed by this phenomenon. We have seen the cumulo-stratus cloud in the horizon start into view during the play of summer lightning. Saussure informs us that he observed sheet-lightning in the direction of Geneva, from the Hospice *du Grimsl, on the* 10th-11th July, 1783, while at the same time a *terrific thunder-storm* raged at Geneva. Howard mentions that from *Tottenham, near* London, on July 31st, 1813, he saw sheet-lightning

towards the S.E. while the sky was bespangled with stars, not a cloud floating in the air; at the same time a thunder-storm raged at Hastings, and in France, from Calais to Dunkirk. Arago instances the following illustration in support of his opinion, that this phenomenon is reflected lightning:—In 1803, when observations were being made for determining longitude, M. de Zach, on the Brocken, used a few ounces of gunpowder as a signal, the flash of which was visible from the Klenlenberg, 60 leagues off, though these mountains are invisible from each other."

SCIENTIFIC BALLOON ASCENTS.

Two ascents have been made from Vauxhall Gardens, by the Kew Committee, in addition to the two ascents already noticed at page 111 of the present volume. The fourth descent, on November 10th, took place at Acryse, about four miles from Folkestone. There were only about four miles more of land available,—a space which at the rate of the balloon's progress in the higher part of its course, would have been passed over in four or five minutes. The rate of the upper currents was probably sometimes more than sixty miles an hour. It is plain, from the results of the last two ascents, that London, from its proximity to the sea and the great prevalence of westerly currents in the upper regions of the atmosphere, is not well suited as a starting point for such experiments. Although this fourth ascent was, on the whole, rather hurried, a good and regular series of observations was obtained. The height reached was considerably greater than in any other of the series now completed; being about the same as that attained by Gay-Lussac in his memorable expedition,—also as in the late ascent by Messrs. Barral and Bixio. The Nassau-Balloon was inflated with carburetted hydrogen, whereas the French aeronauts used pure hydrogen. The greatest elevation ever attained by means of a balloon was during an ascent with the Nassau, by Mr. Green, in company with the late Mr. Rush, in 1838. The height exceeded 27,000 feet,—the balloon being at that time considerably lighter and somewhat larger than it is now.

GREENWICH OBSERVATORY.—GALVANIC CONNEXION WITH LONDON AND THE CONTINENT.

By far the most remarkable work connected with the Observatory during the past year, has been the effecting a galvanic connexion with London and the Continent. To this most important object the Astronomer Royal devoted much time and attention. At the Annual Visitation he informed the Board of Visitors, that four insulated wires are now laid in the ground, at depths varying from three to five feet, at a line commencing at the ground floor of the north dome (now called the galvanic room), across the front court, along the centres of the great avenues of the Park, and across Blackheath, to the Lewisham station; from which point two wires are carried, sometimes on poles and sometimes in grooved boards. to the London-*bridge terminus*, where the connexions will be made either with the

long Dover wires communicating with the continent, or with the wires which extend to the Central Telegraph Station. In connexion with this work is the transmission of accurate Greenwich mean time, by galvanic signals, to London and elsewhere. For this purpose a clock has been constructed, possessing the two properties of exhibiting accurate time and completing galvanic circuits at certain determinate instants of that time. Mr. Shepherd undertook the construction of such a clock. The former condition is obtained by a mechanical action on the pendulum, and the latter by breaking the galvanic circuit at three places. One of these beautiful clocks was exhibited at Lord Rosse's first *soirée*. Mr. Airy has placed a large external dial for the public use near the entrance gate of the Observatory. These galvanic connexions are the most important features in the history of our great national Observatory during the past year; and, as the Astronomer Royal justly remarked, were imperatively required by the advances of practical art, and by the demands of science and of society.—*Literary Gazette*, No. 1847.

TOTAL SOLAR ECLIPSE IN 1852.

THERE have been communicated to the Astronomical Society, a "Note respecting the Pink Projections from the Sun's Disc observed during the Total Solar Eclipse observed in 1851," By C. Babbage, Esq. On reading the accounts of the observations of the solar eclipse of 1852 in the "Notices of the Astronomical Society" for January, I could not but regret (says Mr. Babbage,) the shortness of the time, about 3¼ minutes, during which those interesting and important pink excrescences could be observed. It occurred to me that it might not be impossible to render them visible at other times and under ordinary circumstances. I am induced to throw out the following suggestions, with the hope that they may fall into the hands of those who may possess instruments and leisure to make trial of the plans. 1st. I had on several occasions used small pieces of thin sheet metal placed in the focus of the object-glass of a telescope, for the purpose of covering a portion of the field, and thus obscuring the light of the moon, a planet, or a large star, in order to observe more clearly small stars or satellites in their immediate neighbourhood. I had also, in making some experiments in order to ascertain the cause of the apparent projections of certain stars upon and within the moon's disc, produced a series of artificial occultations of the sun's light reflected from a thermometer bulb placed at the end of my garden. This was accomplished by causing a circle of sheet iron, whose circumference was cut into a series of equi-distant notches and placed immediately before the artificial star, to revolve by clock-work at the sun's rate at which the moon passes over the star. It therefore immediately struck me, that by placing a disc of the same magnitude as the sun's image in the focus of a telescope mounted equatorially, and moving by clock-work, a continual and apparently total eclipse of the sun might be produced. If all light were carefully excluded, it seems not improbable that the pink projections would, under

these circumstances, become perceptible. 2nd. In case this plan should not succeed, I proposed to use the same means in the focus of the object glass, and to project the sun's image in a darkened chamber upon photographic paper or on silver. The direct rays of the sun being cut off, it is possible that the pink projections may have sufficient power to act on the prepared materials presented to them, and we might thus obtain solar pictures of these appendages. Even if success should not attend either of these methods, the preparations made for the latter plan might furnish us with a highly interesting series of representations of the solar spots. The connexion of these pink prominences with a species of volcanic action connected with the solar spots seems probable from the observations recorded. The fact that one of these pink clouds was entirely dissevered from the sun's limb may be accounted for by supposing it to have arisen from a spot on the farther side of the sun. Those who have observed the dense lofty column of smoke arising in a clear calm day to great heights above a crater, have also occasionally observed the top of the column of smoke, on reaching a gentle current of air, pass on horizontally to great distances. Such a horizontal column, seen endways from a point at a great distance from our planet, might appear to be entirely disconnected from it by any continuous line of smoke.

TOTAL ECLIPSE OF THE MOON AT SANTO DOMINGO, JANUARY 6, 1852.

SIR ROBERT SCHOMBURGK has communicated to the *Athenæum*, No. 1278, the following very interesting account of his observation of this phenomenon :—

It was a lovely tropical night, no cloud to be seen,—and the stars shone brightly, without much twinkling. The light which the moon shed while advancing towards the zenith was so clear, that moderate sized print could be read with facility.

The moon stood on the zenith,—and the picture changed its character. The shadows that gave a romantic hue to the ghastly buildings of former centuries were wanting now,—and the outlines seemed harsh under a light that fell perpendicularly upon them.

It was then midnight. The shadow of the earth approached the luminary, and gradually stole over the bright disk of the fair moon. I stood alone upon the flat roof of the house which I inhabited, watching the progress of the eclipse. I pictured in imagination the lively and extraordinary scene which I once witnessed far in the interior of Guiana, among the untutored and superstitious Indians. How they rushed out of their huts when the first news of the eclipse came,—gibbered in their tongue,—and with violent gesticulations threw up their clenched fists towards the moon. When, as on this occasion the disk was perfectly eclipsed, they broke out in moanings, —and sullenly squatted upon the ground, hiding their faces between their hands. The females remained during these strange scenes within their huts. When, shining like a sparkling diamond, the first portion of the moon that had disencumbered itself from the shadow became visible, all eyes were turned towards it. They spoke to each other with subdued voices; but their observations became

louder and louder,—and they quitted their stooping position as the light increased. When the bright disk announced that the monster which wanted to stifle the Queen of the Night had been overcome, the great joy of the Indians was expressed in that peculiar whoop which in the stillness of the night may be heard for a great distance.

The central eclipse took place at half-past one. The moon was then west of the meridian, and in the constellation Gemini,—its eastern limb being about 8° from Pollux and 10° from Castor. *Delta* Geminorum nearly sat on the north-eastern rim:—to the eye there seemed only a small space between it and the moon. South-west of its limb, but at a somewhat greater distance, was *Zeta* Geminorum:—the orb of the moon between them having, for all I can now think of, the appearance of a Chinese round lantern.

The town lay in total darkness. There was the copper-coloured disk on the firmament,—but it shed no ray of light, and the terrestrial objects cast no shadows. But the stars shone all the brighter. Jupiter stood in the zenith; to the south-west the splendid constellation of Orion with Procyon,—and closer to the southern horizon Canopus and that fitful star *Eta* Argûs, now nearly as large as Canopus. The southern Cross seemed to dip its foot in the Ocean.

The moon remained for an hour and forty minutes totally eclipsed. The shadow of the earth entirely covered her during that period; but, as if to confirm the supposition of some astronomers that this luminary possesses an inherent brilliancy, the shadow did not cover her in a uniform manner. Her mountains, valleys, craters, and plains were still to be discerned—chiefly during the middle of the eclipse—near her eastern limb. Whether the light derived from our atmosphere could alone produce such an effect, I must leave to those deeply versed in the science of Astronomy to decide.

It happened—perhaps by accident—that during the period when the moon was entirely plunged in the shadow of the earth, numerous shooting stars became visible:—the greater number flitting in an oblique line from south-east to north-west—one in a right direction towards the moon. It did not seem to belong to our atmosphere; for as far as the naked eye could discern, the moon hid it,—nor did I see its emersion. I had just laid aside the telescope.

The most interesting sight was, however, when the shadow moved away, and exposed—in the commencement very gradually—the unencumbered disk. The brilliant light of the first portion of the moon showed itself like an excrescence on the still to appearance perfectly round disk of the shadowed orb:—and when the illuminated portion amounted in extent to 8′ 10″, the appearance of the moon—perhaps now distorted—presented the excrescence as overlapping the still rounded shadowy disk.

NEW PLANETS.

At 11 hours 30 minutes mean time, on the night of August 22, Mr. Hind discovered at Mr. Bishop's Observatory, Regent's Park, another planet, the *sixth he* has detected during the past five years—a suffi-

cient proof that the members of the planetary system must be far more numerous than was formerly supposed. It is in the constellation Aquarius, and will be readily seen with a telescope of very ordinary power. In brightness it equals a star of the ninth magnitude, and appears to have the same yellowish tinge that has been noticed about Pallas, Melpomene, and others of the same group of planets. At 11 hours 35 minutes 38 seconds, Greenwich mean time (August 22). its right ascension was 22 hours 22 minutes 29·7 seconds, and its north polar distance 97° 32′ 14″; the diurnal motion in right ascension is 53 seconds towards the west, and in N.P.D. about 5′ towards the south.

On November 16, Mr. Hind detected also a small planet, the following elements of which have been calculated by Mr. Vogel, assistant at this observatory:—

	°	′	″
Mean anomaly, counted from perihelion on Nov. 30, at Greenwich, noon	22	27	0
Longitude of the perihelion	46	13	29
Longitude of ascending node	66	53	6
Inclination to the ecliptic	14	20	13
Mean distance from the sun	2.9412		
Eccentricity	0.10458		

Period of revolution, 1,842 days, or rather over five years.

For this early knowledge of the planet's orbit we are mainly indebted to the observations of Mr. Hartnup, of Liverpool, and it is only one of many instances where astronomy has benefited by the establishment of the fine observatory in that town, which is supported by the enlightened liberality of the Corporation.

Mr. Adams having undertaken, at Mr. Bishop's request, to select a name for this our seventh planet, proposes to call it "Calliope." The discovery was not fully verified, owing to the cloudy state of the atmosphere, until the night of November 17, or early on the following morning. Calliope, whose office in ancient mythology required her to perpetuate the illustrious deeds of heroes, can hardly fail to remind us of the event of November 18th, when the homage of so many nations was paid to the memory of the greatest hero of modern times.

On Thursday night, June 24th, Mr. Hind discovered another new Planet on the borders of the constellations Aquila and Serpens, about 5° east of the star Tau in Ophiuchus. The newly found planet, to use the words of Mr. Hind, "shines as a fine star of between the eighth and ninth magnitudes, and has a very steady yellow light. At moments it appeared to have a disk, but the night was not sufficiently favourable for high magnifiers. At 13h. 13m. 16s. mean time, its right ascension was 18h. 12m. 58·8s., and its north polar distance 98° 16′ 0·9″. The diurnal motion in R. A. is about 1m. 2s. towards the west, and in N. P. D. two or three minutes towards the south."

GIGANTIC TELESCOPE AT WANDSWORTH COMMON.

A STUPENDOUS Telescope has been constructed on Wandsworth *Common*, under the general superintendence of Mr. Gravatt,

for the Rev. Mr. Craig, Vicar of Leamington. It consists of a brick tower, 64 feet in height, and 15 feet in diameter, with a long tube slung at its side. The length of this tube, which is shaped somewhat like a cigar, is 76 feet; but with an eye-piece at the narrow end, and a dew-cap at the other, the total length in use will be 85 feet. The design of the dew-cap is to prevent obscuration by the condensation of moisture which takes place during the night, when the instrument is most in use. Its exterior is of bright metal, the interior is painted black. The focal distance varies from 76 to 85 feet. The tube at its greatest circumference measures 13 feet, and this part is about 24 feet from the object-glass. The determination of this point was the result of repeated experiments and minute and careful calculations. It was essential to the object in view that there should not be the slightest vibration in the instrument. Mr. Gravatt, reasoning from analogy, applied the principle of harmonic progression to the perfecting of an instrument for extending the range of vision, and thus aiding astronomic research. By his improvements it is stated, the vibration at one end of the tube is neutralized by that at the other, and the utmost steadiness and precision are attained. The iron-work of the tube was manufactured by Messrs. Rennie, under the direction of Mr. Gravatt. The object-glass, and all the optical works were executed by Mr. Thomas Slater. Two glasses are used: one of flint, the other of plate glass. The plate-glass lens has a positive focal length of 30 feet 1½ inches; its refractive index is 1,5103. The flint-glass lens has a negative focal length of 49 feet 10¼ inches; and the refractive index of this glass is 1,6308. These two lenses, placed in contact, are used in combination, and constitute the achromatic object-glass, the focal length of which is 76 ft. to parallel rays—that is, to all celestial objects, and it would be 85 ft. focal length only to objects at about 700 ft. distance from the object-glass. The tube rests upon a light wooden framework, with iron wheels attached, and is fitted to a circular iron railway at a distance of 52 feet from the centre of the tower. The chain by which it is lowered is capable of sustaining a weight of 13 tons, though the weight of the tube is only 3. Notwithstanding the immense size of the instrument, the machinery is such that it can move either in azimuth, or up to an altitude of 80°, with as much ease and rapidity as an ordinary telescope, and, from the nature of the mechanical arrangements, with far greater certainty as to results. The slightest force applied to the wheel on the iron rail causes the instrument to move horizontally round the central tower, while a wheel at the right hand of the observer enables him to elevate or depress the object-glass with the greatest precision and facility. The largest eyepiece made for this instrument subtends to an angle of 30 minutes, its magnifying power is 125, and the diameter of the lenses 8 inches, which is about the size of the image of the full moon. The next size eyepiece is 4 inches diameter, subtends to an angle of 15 minutes, and magnifies 250. The range of eyepieces then vary from angles of 9 minutes to 50 seconds, and the magnifying powers from 500 to 3000. A popular *notion of the extraordinary* magnifying power of this instrument is

conveyed by the statement, that by it a quarter-inch letter can be read at the distance of half-a-mile. It should, however, be added, that the accounts of the construction and performances of this telescope have been confused and unsatisfactory; and, among other objections, it is urged that the effective part, the ring around the centre, cannot be good, as the second lens is of *plate-glass*, not *crown-glass;* therefore cannot be achromatic.

BRILLIANT METEOR.

A Brilliant Meteor appeared on Monday, August 12th, 1852, at about 9h. 20m. P.M., Greenwich time. Mr. Glaisher, in the *Philosophical Magazine*, has published the accounts of several observers, with the results of his calculations made to determine the distance of the meteor from the earth. From the majority of the accounts, the meteor was almost stationary for a very considerable time before it disappeared. From the various altitudes given, Mr. Glaisher considers its distance from the earth to have been 65 miles. The only furnished data for determining the path of the meteor in the heavens, are that it was moving towards the west, and approaching the earth. All the observers describe its colour to have been an intense blue, of extreme brilliancy, and very great size.

HURRICANE AT ATHENS.

On the 26th October there occurred at Athens, a storm of wind and rain, increasing to a gale at nine P.M., and to a Hurricane from ten to half-past eleven. The streets of Athens presented the next morning a scene of desolation, being strewed with branches of trees, tiles, glass, signboards, cornices, &c. The whole of the roof of the south-west side of the British Chapel, and great part of that on the north-east, had been torn off, the windows broken, and the few trees we had round it torn up by the roots. Inside, of course, desolation reigned. A river of water was running down the pulpit steps, the font half full of rain water, sand, &c.; the damage done to the church alone being estimated at several thousand drachmas.

Two of the columns of the Erechtheum on the west side had also fallen, and broken in pieces. The two beautiful Cypresses, one by the Tower of the Winds, the other by the mosque in the Agora, were down; one of them snapped in two, ten feet from the ground. There was immense damage done to the Palace garden, where all the large trees are down; the interior of the Palace was greatly injured on the south side. The large trees in the square, opposite the British Minister's, were blown down. At the Piræus upwards of sixty caiques and boats were utterly destroyed. Two large merchant ships laden with corn were lost; and the *Amelia* corvette was wrecked on Salamis, having on board the families of several officers, including thirty-six women. Two men were lost, but all the women were saved.

The fall of one of the columns of the Temple of Jupiter Olympus is thus described by an eye-witness, in the *Illustrated London News:*

On the night of the 26th of October the centre pillar of the three

which formed a part of the inner South peristyle of the Temple of Jupiter Olympius, at Athens, was thrown down by a gale from the south-east. The column fell due north, and lies prostrate, the drums (the sections of the shaft) preserving nearly their relative positions, although separated. The lowest drum retains its situation on the base; the base and it being both inclined to the north, at an angle of perhaps 45 degrees. The fallen pieces lie horizontally, and nearly touch each other, like bricks arranged to knock each other down in their fall. The upper half of the capital, with its Corinthian volutes, is completely capsized. The square marble base of the column rested upon two square courses of coarse lime-stone, two feet thick each course. The soil or earth giving way under the north side of the pillar, the course broke across from east to west; and when the column was inclined at a certain angle, the second drum (or section) slipped off the first or lowest, carrying with it all the upper column in one piece. The column fell at a right angle to the long diameter of the Temple, which lies east and west. The drums were each connected by two small iron bars, five inches long and an inch and a half square, fitted with lead into the marble, so as to prevent the oxidation of the iron discolouring the marble. These bars are either drawn from their sockets or broken across. The centres of the planes of the drums are left rough, and some have a square hole cut, which, perhaps, was for an iron bar. The iron bars used are placed near the circumference, opposite each other, in the line of a diameter of the circle. The pillar is capable of being re-erected.

ODYLIC LIGHT.—AURORA BOREALIS.

We quote the following from an interesting Lecture delivered by Dr. Evanson to the Torquay Natural History Society :—

The new and important fact in Physical Science, that Light emanates from the Magnet, having been determined by experiment, Reichenbach was desirous of still further investigating the similarity or identity between this light and the Aurora Borealis ; though conscious that the constitution or condition of a light, seen only by sensitives in the dark, and one obvious to all beholders, could hardly be regarded as identical, however similar. To decide this question a most ingenious experiment was devised ; which we cannot do better than record in the words of Dr. Gregory, the Translator of Reichenbach's work, and himself an eminent Scientific Author. Dr. Gregory writes as follows :—

"As magnets emit beautiful Odylic Light, so the earth, which is a vast magnet, emits its Odylic Light; which, in consequence of the great size and enormous power of the magnet concerned, becomes visible to all eyes, perhaps more vividly to the sensitive; but this is not easy to ascertain. This is not a mere hypothesis. It is supported by a series of the most beautiful experiments with which I am acquainted. Reichenbach converted a large iron globe, two or three feet in diameter, into a powerful temporary magnet, by causing an electric current to traverse a wire coiled round a bar

of iron passing from pole to pole of the sphere. When the globe was suspended in the air, in an absolutely dark room, the sensitives saw the Odylic Light in the most exquisite beauty, and with all the peculiar characters of the Aurora Borealis and the Aurora Australis. At each pole appeared a wide circle of light, more blue at the northward, more red at the southward pole, but at both with all the rainbow hues. The Equator was marked by a luminous belt, towards which, on or close above the surface of the sphere, lines of light constantly streamed from the polar circles. In the polar circles, as well as in the streaming lines, the colours were arranged so that red predominated in one quarter, the south, blue in the opposite, yellow in the west, and opposite to it, grey, or the absence of colour, white; and in all the Odylic rainbows, a narrow stripe of red appeared near the grey, at the end of the iris most remote from the great mass of red,—a most beautiful confirmation of Sir David Brewster's analysis of the spectrum. The delicate streaming lines or threads of light passed by insensible gradations from one colour to the other, so that any two contiguous lines appeared to have the same colour, yet, on looking a little further on, the colour gradually changed, and thus the whole of the rainbow hues appeared in their order, red, orange, yellow, green, blue, indigo, violet, and last of all the small red stripe, and the grey. But the passage from red to orange, or from orange to yellow, &c., was not sudden, but slow and gradual, so that all the intermediate tints were seen. Nor was this all, for in the air, above each pole appeared a splendid crown or umbel of light, more blue at the northward, more red at the southward, but exhibiting also all the colours, and sending towards the Equator splendid streamers of many-coloured light, dancing and leaping, lengthening and shortening, just as the finest northern streamers do, to the delighted eye of the observer. I cannot here enter into a full description of this artificial Aurora, the first ever produced; but I may record my conviction, that this experiment gives, to that theory which regards the Aurora as Odylic Light, a degree of probability far greater than attaches to any other theory of that phenomenon. I may observe also, that the Aurora does not cease to be a magnetic phenomenon; and that it should affect the needle is to be expected, since, in magnets, Odylic influence and Odylic Light are found associated with the ferro-magnetic influence."

METEOROLOGY OF 1852.

Results deduced from the Meteorological Register kept at the Royal Observatory, Greenwich, during the year 1852, *under the Superintendence of the Astronomer Royal.*

Months.	Mean Reading of Barom.	Mean Tension of Vapour.	Mean Pressure of Dry Air.	Temperature of Air.							Temperature of				Rain.		Weight of Vapour in Cubic ft. of Air.	Mean additional Weight required to saturate a cubic foot of Air.	Mean Degree of Humidity.	Mean Weight of a cubic foot of Air.
				Self-Reg. Therm.	Dry Bulb Therm.	Adopted.	Highest.	Lowest.	Range.	Mean Daily Range.	Evap.	Evap. below Air.	Dew Point below Air.	Dew Point.	No. of Days.	Amount in Inches.				
	In.	In.	In.	°	°	°	°	°	°	°	°	°	°	°		Ins.	Gr.	Gr.		Gr.
Jan ……	29·589	·230	29·359	42·1	41·9	42·0	55·5	28·1	27·4	11·4	39·2	2·8	6·4	35·6	16	3·6	2·7	0·4	·847	543
Feb ……	29·857	·221	29·636	41·0	40·8	40·8	57·4	24·9	32·5	12·2	38·3	2·5	6·2	34·6	10	0·9	2·6	0·4	·879	549
March..	30·007	·210	29·797	41·3	41·3	41·3	68·4	21·3	47·1	18·6	38·2	3·1	7·4	33·9	3	0·2	2·5	0·7	·810	551
April….	29·945	·245	29·700	44·7	45·9	45·9	74·7	26·7	48·0	24·0	42·3	3·6	7.9	38·0	2	0·5	2·8	0·9	·757	545
May……	29·786	·302	29·484	50·8	51·5	51·5	73·4	29·3	44·1	18·6	47·8	3·7	7.7	43·8	12	1·9	3·5	1·1	·773	535
June …	29·560	·351	29·209	56·2	56·1	56·1	72·7	41·0	31·7	17·1	52 0	4·1	7.9	48·2	21	4·6	4·0	1·2	·767	526
July …	29 857	·475	29·382	66·3	66·7	66 6	90·3	49·2	41·1	24 9	60·7	5·9	9·4	57·2	4	2·3	5·3	1·9	·732	520
Aug……	29·649	·407	29·242	62·0	62·1	62·1	81·5	49·9	31·6	17·9	56·6	5·5	9·4	52·7	15	4·5	4·6	1·7	·728	521
Sept …	29·739	·360	29·379	56·9	56·7	56·8	77·5	40·9	36·6	17·4	52·7	4·1	7·8	49·0	13	3·9	4·1	1·2	·772	528
Oct ……	29·687	·279	29·408	47·9	47·8	47.9	64·0	31·0	33·0	14·6	45·0	2·9	6·6	41·3	15	3·8	3·2	0·8	·803	538
Nov ……	29·465	·296	29·169	49·2	48·7	48.9	63·8	32·6	31·2	10·4	46·3	2·6	5·5	43·4	22	6·0	3·4	0·7	·828	534
Dec……	29·581	·271	29·310	47·5	47·7	47·6	57·1	31·7	25·4	9·7	44·5	3·1	6·7	40·9	19	2·2	3·1	0·8	·794	536

EXPLANATION.

The cistern of the barometer is about 159 feet above the level of the sea, and its readings are coincident with those of the Royal Society's flint-glass barometer. The observations are taken daily at 9 A.M., noon, 3 P.M., and 9. P.M.; the means of these readings are corrected for diurnal ranges by the application of Mr. Glaisher's corrections, as published in the *Philosophical Transactions*, Part I. 1848, and from the readings of the dry and wet bulb thermometers, thus corrected. The several hygrometric deductions in columns 3, 15, 18, 19, 20 and 21, are calculated by means of Mr. Glaisher's Hygrometric Tables.

The numbers in column 2 show the mean reading of the barometer every month, or the mean length of the column of mercury which balanced the whole weight of atmosphere of air and water; the numbers in column 3 show the length of a column of mercury balanced by the water mixed with the air alone; and the numbers in column 4 show the length of a column of mercury balanced by the air alone, or that the reading of the barometer which would have been had no vapour been mixed with the air.

[*Concluded on next page.*

The numbers in colums 5 and 6 are determinations of the mean temperature of the air by different instruments and methods—those in column 5 by the readings of self-registering thermometers daily, and those in column 6 by the readings of a simple thermometer, taken at the times before mentioned. The numbers in column 7 show the true temperature of the air in every month; those in column 12 the true temperature of evaporation; and those in column 15 the true temperature of the dew point, or that temperature at which the vapour in the air is deposited in the shape of water.

The mean reading of the barometer for the year 1852 was 29·727 inches; the mean temperature of the air for the year was 50°·6; that of evaporation was 47°·0; and that of the dew point was 43°·2. Rain fell on 152 days; and the amount collected was 34·4 inches.

The fall of rain during the year all over the country has been very remarkable. In the months of February, March, and April, there was a drought; but from June rain was almost continuous. The fall in the counties of Cornwall and Devonshire was nearly fifty inches in depth; at Stonyhurst and north Shields, it exceeded 58 inches; and at most other places it was between 30 and 40 inches; and in the Isle of Wight it exceeded 40 inches in depth.

The temperature of January exceeded the average of 80 years by 6½°; February by 2½°; March by ½° nearly, and April was about its average; May was 1° below, June was 2° below; July was 5° in excess; August and September were ½° in excess; October was 1¾° below; November was 6°, and December was 8° in excess, according to Mr. Glaisher's determination of the mean temperature of each month.

The period from October 30 was the most remarkable, a period of longer continuance of warm weather at this season of the year set in on this day, than any on record; the temperature of November was exceeded once only, viz., in 1818; and December in 1806 was the only one which approached the temperature of December, 1852. Thunder storms in the three months ending September were very numerous all over the country, and almost unprecedented falls of rain took place in every month from June. At many places, an inch fell in a few hours; on August 11, rain, to the depth of 3 inches, fell at North Shields in 19 hours. Snow fell on Ben Nevis on the 28th of September.

The harvest began to be gathered at most places between the latitude of 49½° and 53° on the 1st, 2nd, and 3d of August; at Durham on the 16th, at Shields on the 17th, and Devon on the 24th; and harvest was completed, at places south of latitude 53°, between the 17th and 27th of September.*

DESTRUCTIVE STORM AT COLCHESTER.

AMONGST the various thunder-storms which visited different localities of England during last July, one of the most violent descended upon Colchester and its neighbourhood on the night of the 16th, at eleven o'clock, by which a large amount of damage was done to several mills, especially Rainsford Mill, in the occupation of Mr. John Ratcliff. About half-past ten, a whirlwind commenced from the south-east, by which the sails of the above mill were broken, and the cap was blown off. Fortunately, the latter was stayed in its progress downwards by resting its edge upon the curb; one of the sails broke off at the "middling," with the end penetrating the body of the mill. The stage was also nearly demolished. The miller was in bed in the mill at the time the accident occurred, but escaped unhurt. The house is within 15 feet of the mill, and had the cap and sails fallen upon it, the death of the inmates of the house would probably have been the result. The sails and the entire top part of the flock-mill in North-street were thrown on an out-house, the roof of which was forced in. The mills in the Harwich-road, the Military-road, and at Greenstead, all suffered more or less. The fury of the elements lasted nearly an hour and a half, and was succeeded by torrents of rain.

* *For other and more detailed particulars, see Mr. Glaisher's Quarterly Meteorological Reports.*

Obituary List

OF PERSONS EMINENT IN SCIENCE AND ART. 1852.

Andre Buchner, 34 years Professor of Chemistry in the University of Munich.
John Gibson, portrait painter, Edinburgh.
Dr. Achille Richard, Professor of Medical Natural History in the Paris Academy of Sciences.
M. Blanco Luno, proprietor of the large printing establishment, Copenhagen.
Isaac Cullimore, eminent in Egyptian Archæology.
Dr. Thomas Thomson, Regius Professor of Chemistry in the University of Glasgow. He occupied the chemical chair for nearly half a century; and is the author of an excellent "History of Chemistry."
Joseph Allen, landscape painter.
Professor Cowper, a distinguished inventor and improver of machinery; and who accomplished for the Printing Machine that which Watt did for the Steam Engine.
John Dalrymple, eminent Surgeon, and a founder of the College of Chemistry.
M. Dize, eminent Chemist, Paris.
Dr. Stieffel, learned meteorologist, Hamburgh.
Frank Forster, civil engineer.
Alfred Dolman, traveller in South Africa.
Dr. Egilsson, the accomplished linguist, Iceland.
Dr. Eisenstein, of the Royal Academy of Sciences at Berlin, and recognised as the first living Mathematician of Germany.
Vicars Griffith, Assistant Secretary to the Royal Dublin Society.
Gideon Algernon Mantell, LL.D., the distinguished Geologist. One of his latest contributions to science will be found in the present volume—"On the Structure of the Iguanodon," page 254.
Dr. Herbert Mayo, an able contributor to physiological literature.
Count Alfred D'Orsay, artist.
Dr. Pfaff, natural philosopher.
George Richardson Porter, eminent statist.
Samuel Prout, one of the oldest and most distinguished members of the senior Society of Painters in Water-colours.
Augustus Welby Pugin, the distinguished architect.
William Thompson, of Belfast, naturalist.
J. M. W. Turner, R.A., landscape painter.
Jacques Pradier, French sculptor.
F. M. the Duke of Wellington, member of the Institution of Civil Engineers, and remarkable for his courtesy to men of science.
James Savage, Gothic architect.
Thomas Allason, architect.
William Tierney Clark, engineer of the Hammersmith Suspension Bridge.
Captain Sir Samuel Brown, engineer of the "Chain Pier" at Brighton.
Joseph Clinton Robertson, originator and editor of the *Mechanics' Magazine*.
M. Vaillant, natural history painter.
James Fillans, sculptor, Glasgow.
William Finden, the eminent line engraver.
John Nicholas Gannal, chemist, and originator of the celebrated process which bears his name.
William Gardiner, of Dundee, a zealous botanist.
Van Joel, sculptor of the lion of Waterloo.
Dr. Bayard, one of the editors of the *Annales d'Hygiène Publique*.
M. Gruithuisen, one of the most distinguished astronomers of Germany.
Sir John Guest, Bart., one of the largest iron masters in the world, and an ingenious mechanician.
John Painter Vincent, eminent surgeon.
Baron George Frederic de Langsdorff, the well-known German botanist.
M. Hissinger, Swedish mineralogist and geologist.
Tony Johannot, French artist.
John Landseer, line engraver.
Dr. William Macgillivray, professor of natural history, and lecturer on botany, in Marischal College and University, Aberdeen.

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